US011265603B2

(12) **United States Patent**
Oobuchi et al.

(10) **Patent No.: US 11,265,603 B2**
(45) **Date of Patent: Mar. 1, 2022**

(54) **INFORMATION PROCESSING APPARATUS AND METHOD, DISPLAY CONTROL APPARATUS AND METHOD, REPRODUCING APPARATUS AND METHOD, AND INFORMATION PROCESSING SYSTEM**

(71) Applicant: **SONY CORPORATION**, Tokyo (JP)

(72) Inventors: **Yukio Oobuchi**, Kanagawa (JP); **Yuichi Hasegawa**, Tokyo (JP); **Yuki Yamamoto**, Chiba (JP)

(73) Assignee: **SONY CORPORATION**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 144 days.

(21) Appl. No.: **16/713,080**

(22) Filed: **Dec. 13, 2019**

(65) **Prior Publication Data**

US 2020/0120386 A1 Apr. 16, 2020

Related U.S. Application Data

(63) Continuation of application No. 15/323,289, filed as application No. PCT/JP2015/069382 on Jul. 6, 2015, now Pat. No. 10,547,902.

(30) **Foreign Application Priority Data**

Jul. 18, 2014 (JP) 2014-147597

(51) **Int. Cl.**
H04N 21/442 (2011.01)
H04N 21/234 (2011.01)
(Continued)

(52) **U.S. Cl.**
CPC ... ***H04N 21/44218*** (2013.01); ***G06K 9/00718*** (2013.01); ***H04N 5/64*** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

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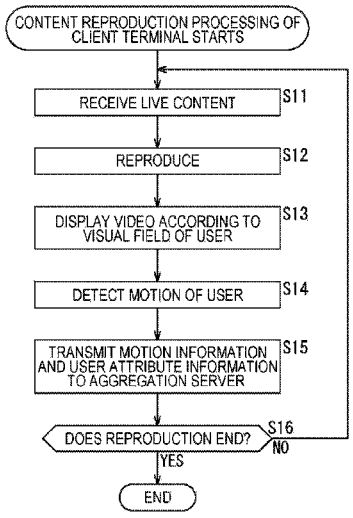
Primary Examiner — Justin E Shepard
(74) *Attorney, Agent, or Firm* — Chip Law Group

(57) **ABSTRACT**

Provided are an information processing apparatus and method, a display control apparatus and method, a reproducing apparatus and method, and an information processing system that transmit a response of viewers acquired in a more natural way to a place where content is captured, enabling presentation in an easier-to-see way. The information processing apparatus receives motion information indicating motions of users watching video content and information indicating attributes of the users, and generates an excitement image by arranging information visually indicating a degree of excitement of each user determined on the basis of the motion information transmitted from a plurality of reproducing apparatuses at a position according to an attribute of each user.

13 Claims, 23 Drawing Sheets



(51) **Int. Cl.**

H04N 21/2668	(2011.01)
H04N 5/64	(2006.01)
H04N 7/15	(2006.01)
G06K 9/00	(2022.01)
H04N 21/2187	(2011.01)
H04N 21/4223	(2011.01)
H04N 21/431	(2011.01)
H04N 21/44	(2011.01)

(52) **U.S. Cl.**

CPC ***H04N 7/15*** (2013.01); ***H04N 21/2187*** (2013.01); ***H04N 21/234*** (2013.01); ***H04N 21/2668*** (2013.01); ***H04N 21/4223*** (2013.01); ***H04N 21/4312*** (2013.01); ***H04N 21/442*** (2013.01); ***H04N 21/44008*** (2013.01)

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FIG. 1

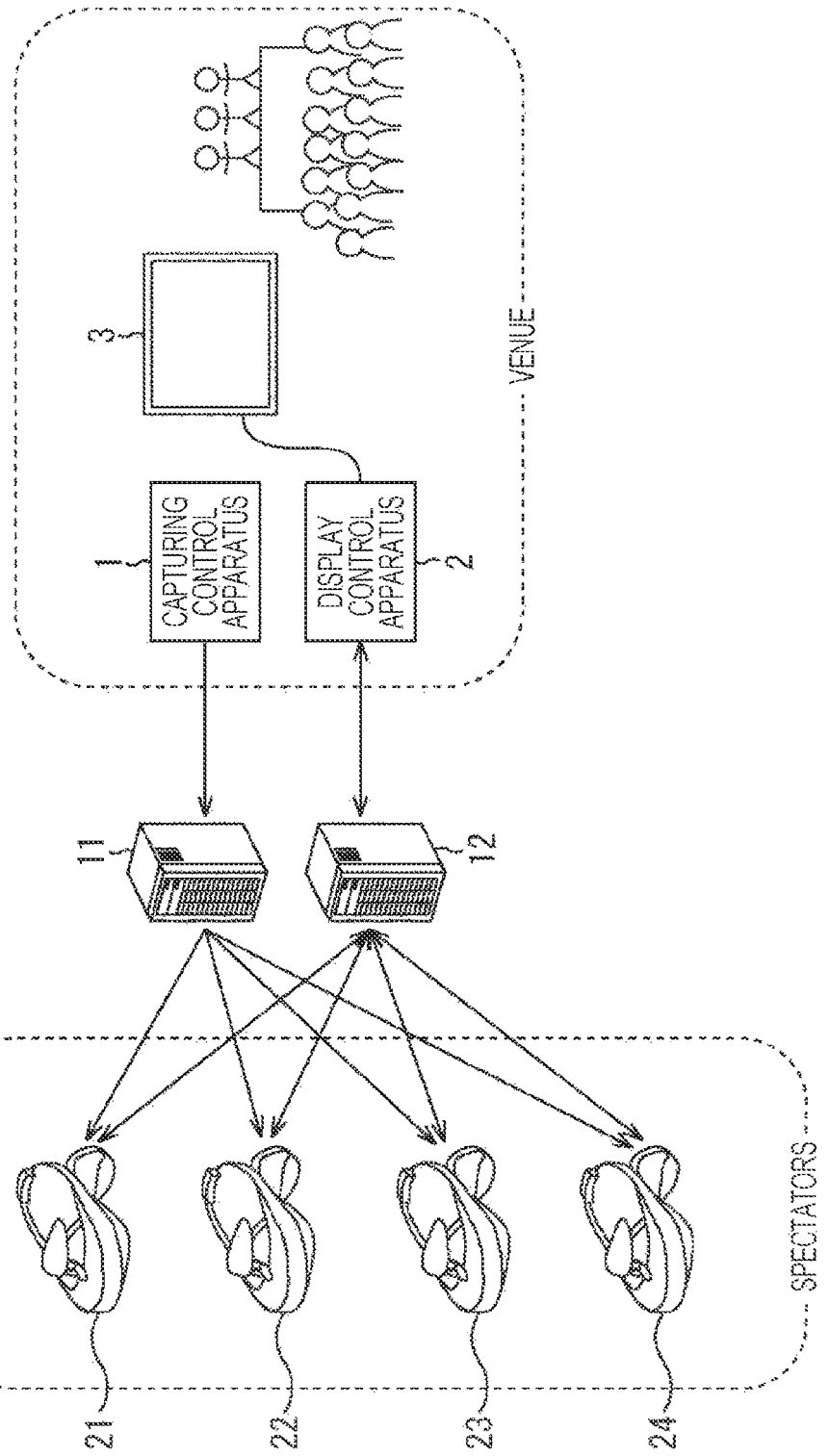

VENUE
3
CAPTURING CONTROL APPARATUS
1
DISPLAY CONTROL APPARATUS
2
11
12
SPECTATORS
21
22
23
24

FIG. 2

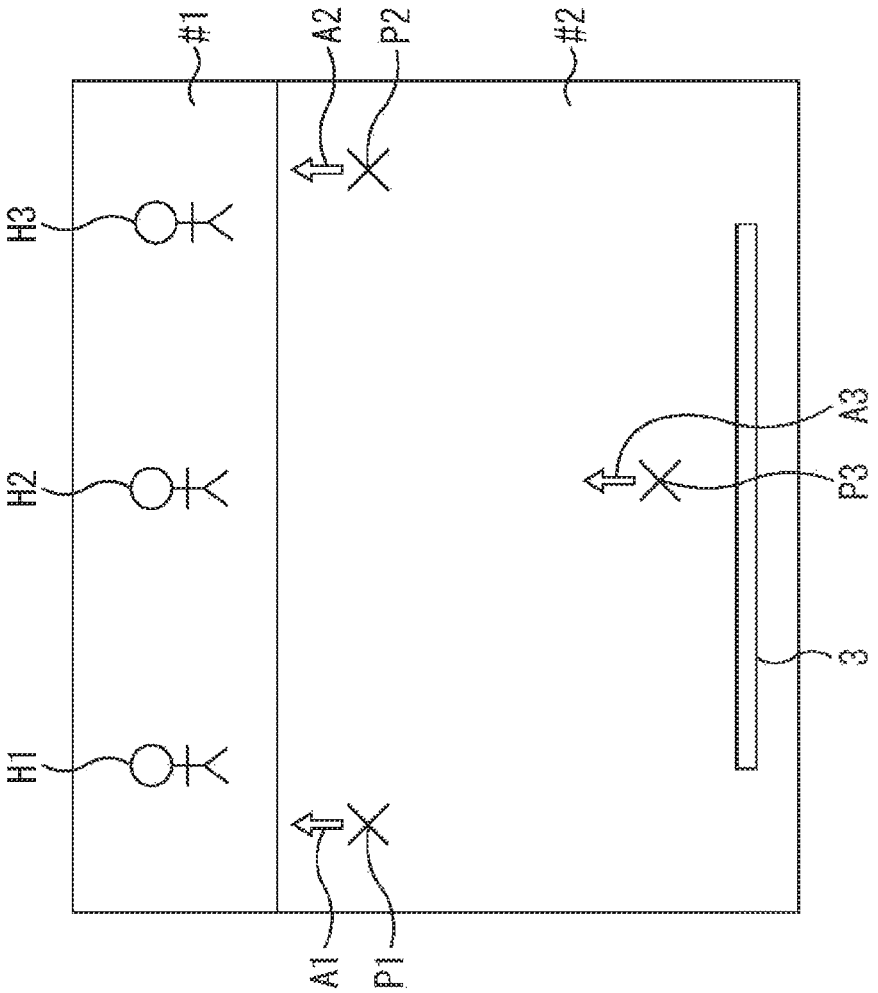


FIG. 3

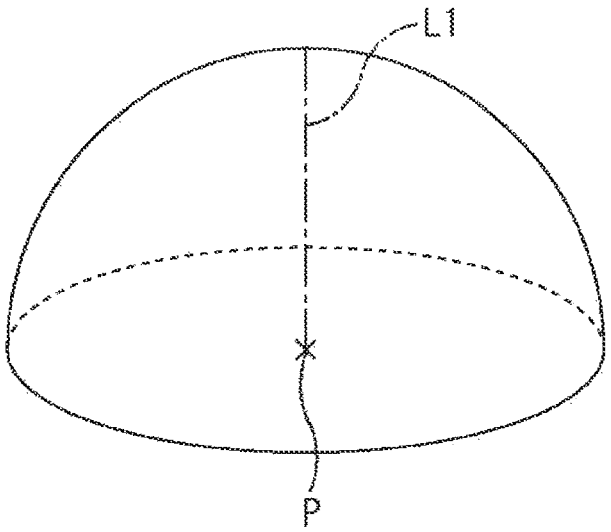


FIG. 4

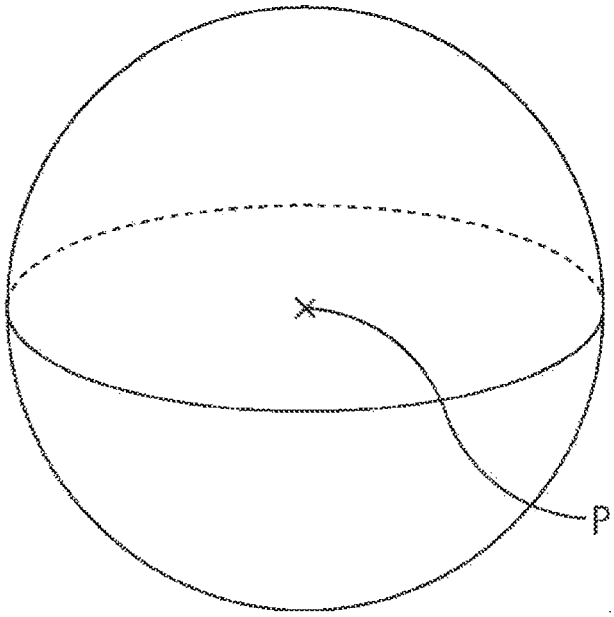


FIG. 5A

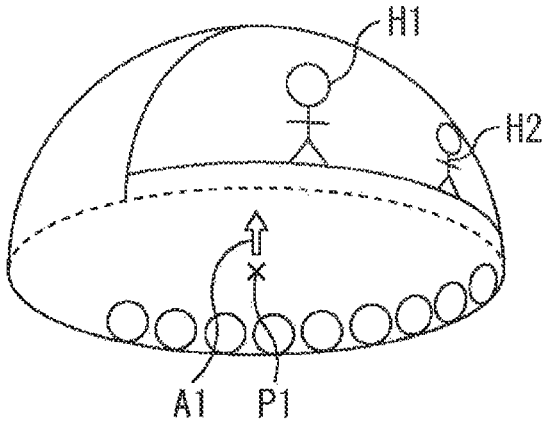


FIG. 5B

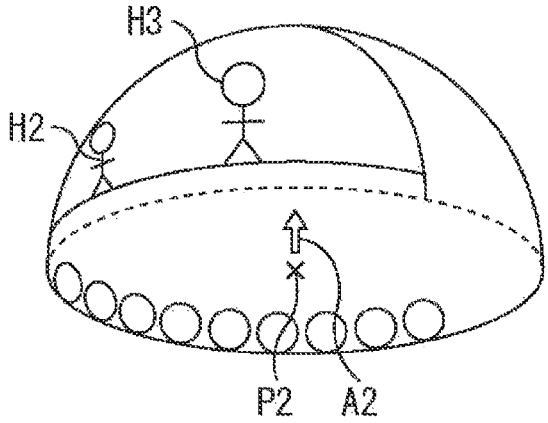


FIG. 5C

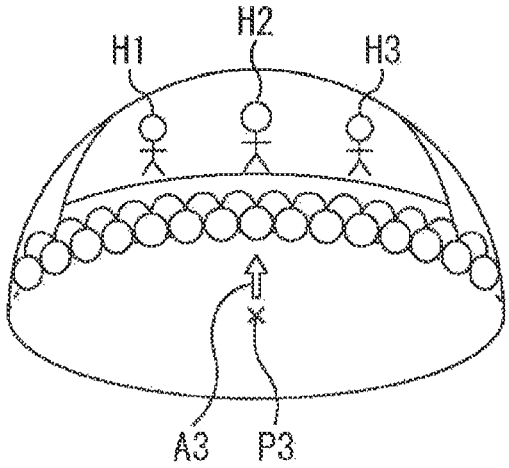


FIG. 6

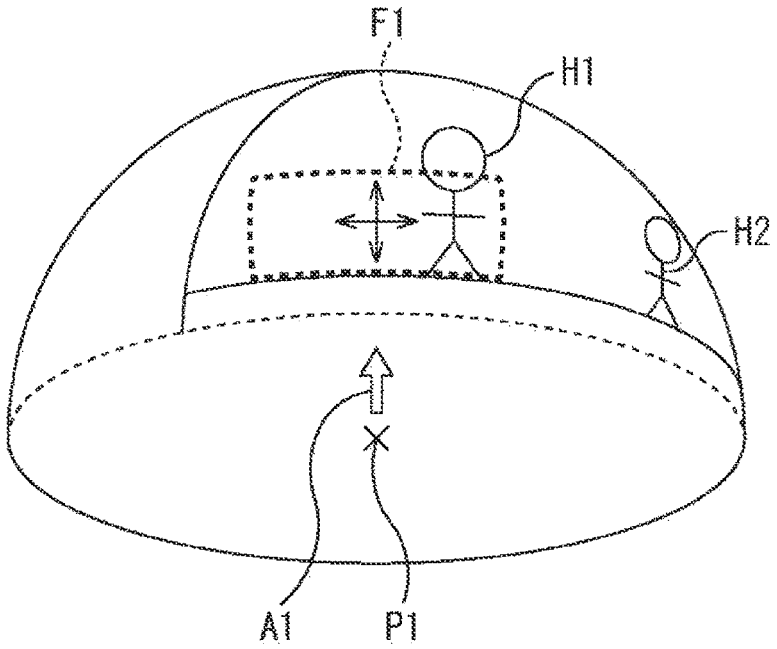


FIG. 7

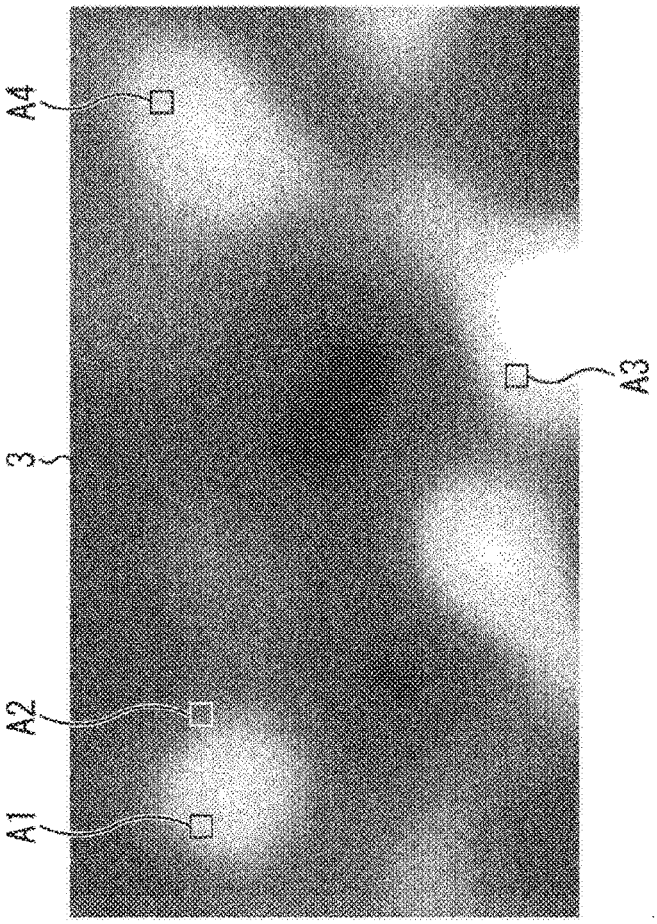


FIG. 8

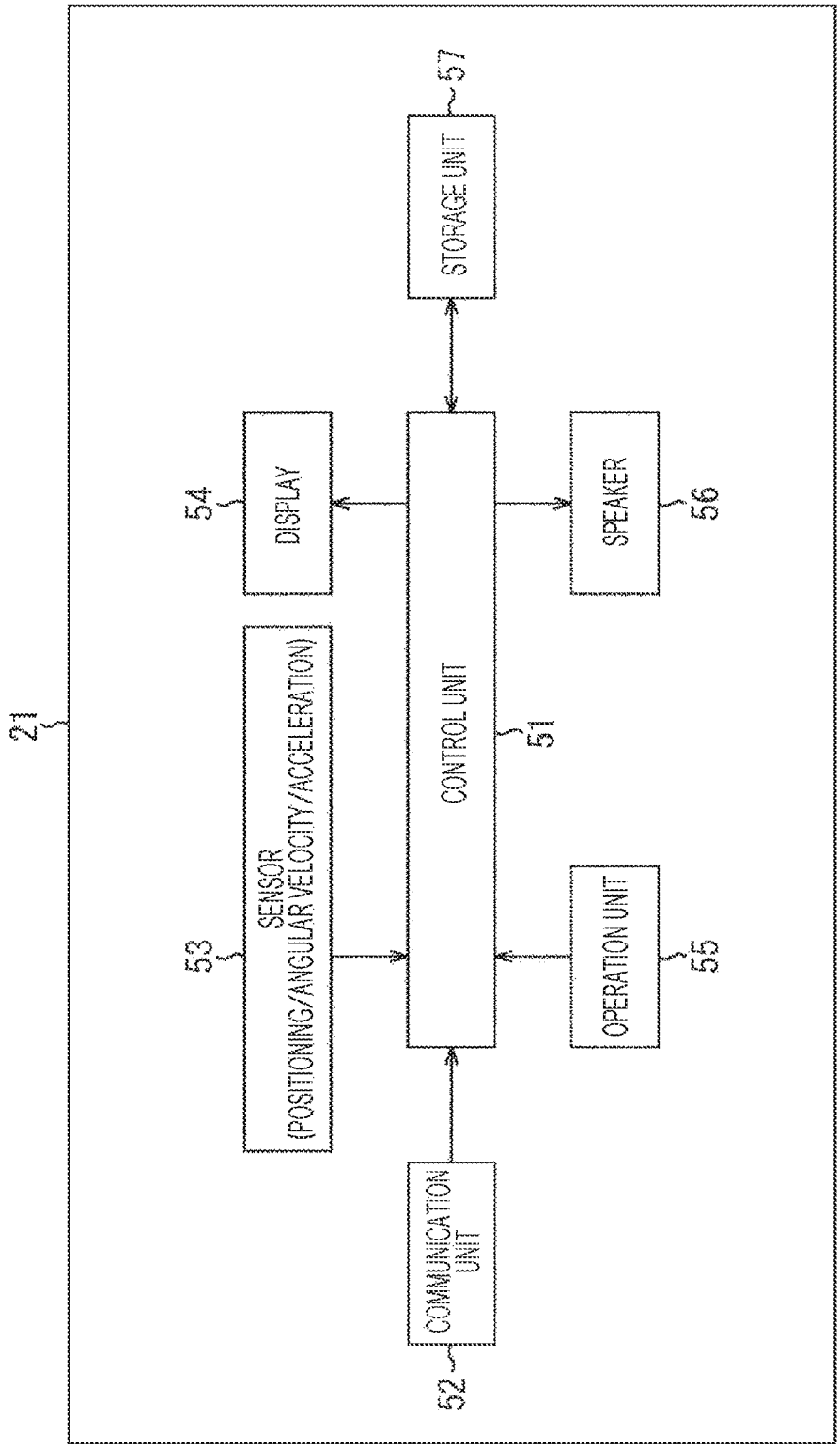

21
STORAGE UNIT
57
DISPLAY
54
SPEAKER
56
CONTROL UNIT
51
SENSOR
(POSITIONING/ANGULAR VELOCITY/ACCELERATION)
53
OPERATION UNIT
55
COMMUNICATION UNIT
52

FIG. 9

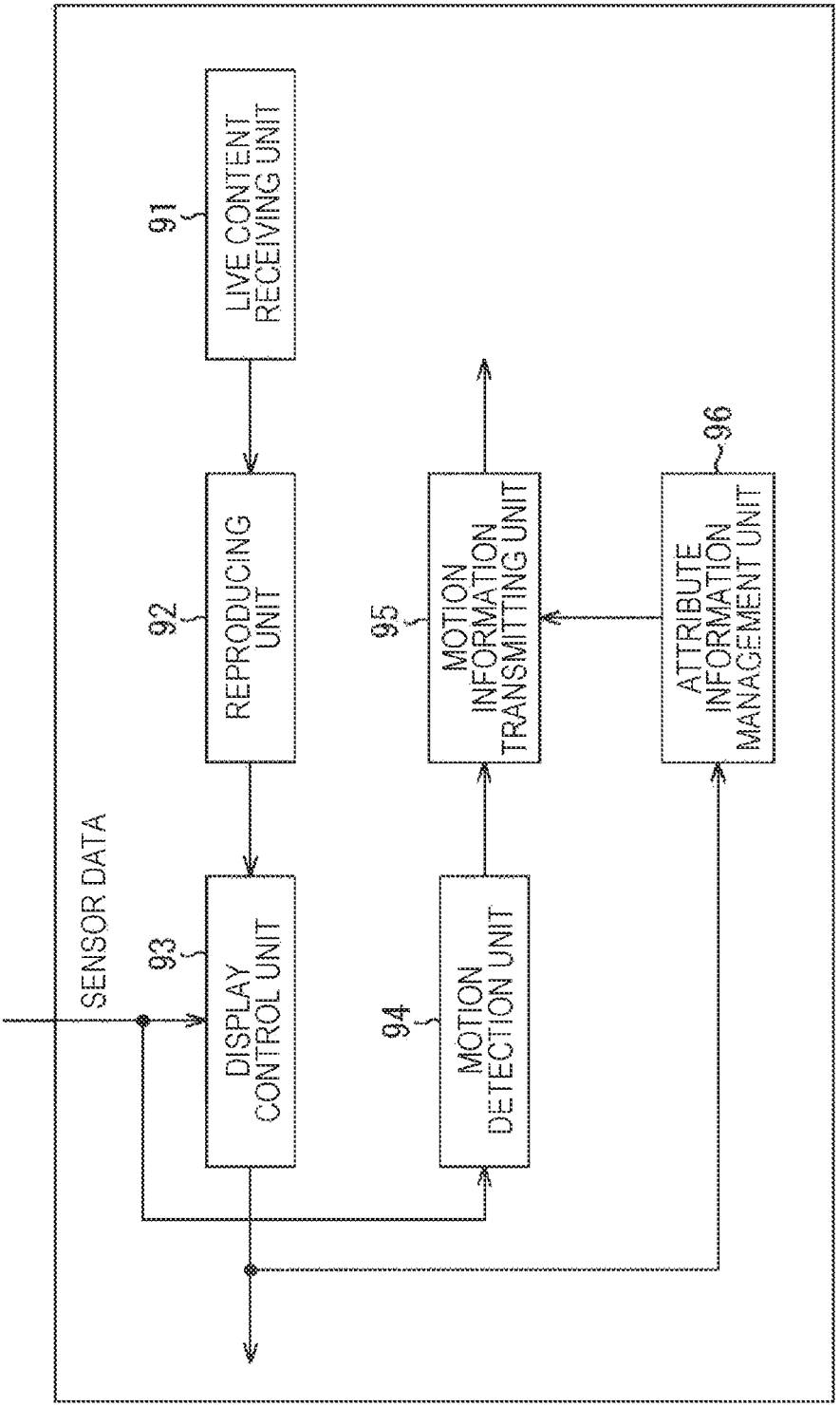

SENSOR DATA
91
LIVE CONTENT RECEIVING UNIT
92
REPRODUCING UNIT
93
DISPLAY CONTROL UNIT
94
MOTION DETECTION UNIT
95
MOTION INFORMATION TRANSMITTING UNIT
96
ATTRIBUTE INFORMATION MANAGEMENT UNIT

FIG. 10

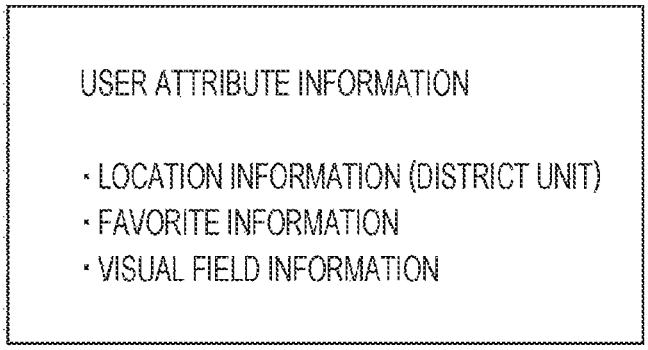

USER ATTRIBUTE INFORMATION
· LOCATION INFORMATION (DISTRICT UNIT)
· FAVORITE INFORMATION
· VISUAL FIELD INFORMATION

FIG. 11

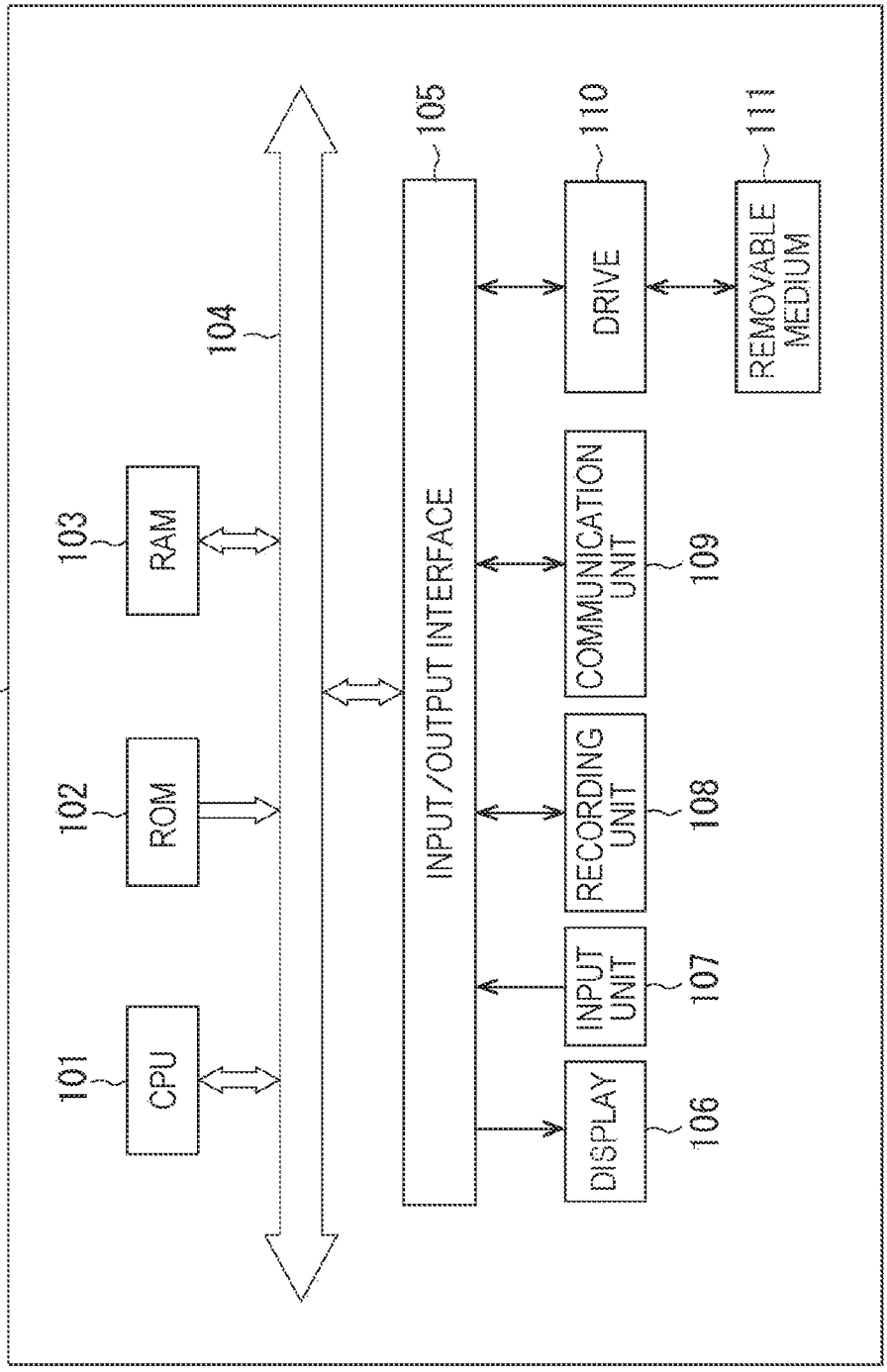

12
101
CPU
102
ROM
103
RAM
104
105
INPUT/OUTPUT INTERFACE
106
DISPLAY
107
INPUT UNIT
108
RECORDING UNIT
109
COMMUNICATION UNIT
110
DRIVE
111
REMOVABLE MEDIUM

FIG. 12

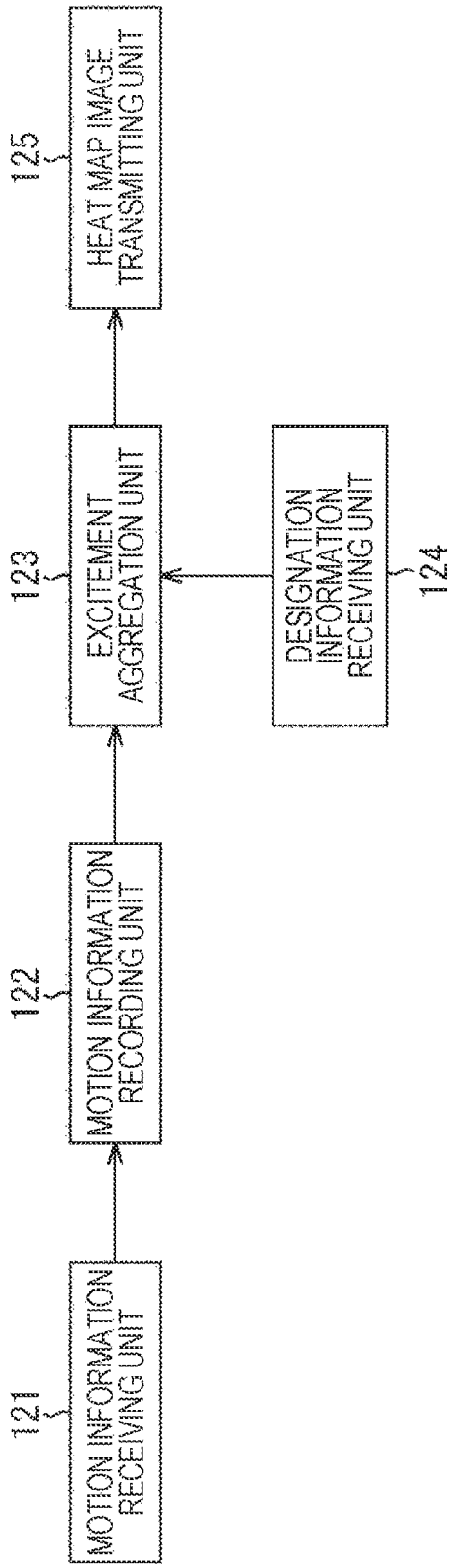

121
MOTION INFORMATION RECEIVING UNIT
122
MOTION INFORMATION RECORDING UNIT
123
EXCITEMENT AGGREGATION UNIT
124
DESIGNATION INFORMATION RECEIVING UNIT
125
HEAT MAP IMAGE TRANSMITTING UNIT

FIG. 13

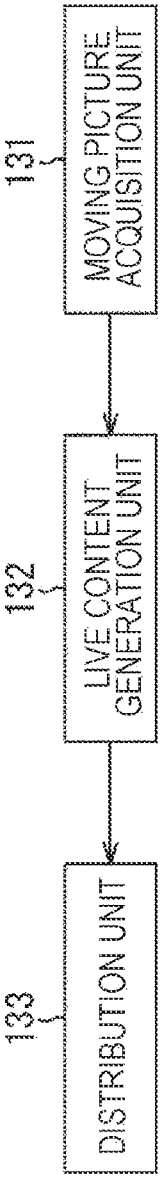

131
MOVING PICTURE ACQUISITION UNIT
132
LIVE CONTENT GENERATION UNIT
133
DISTRIBUTION UNIT

FIG. 14

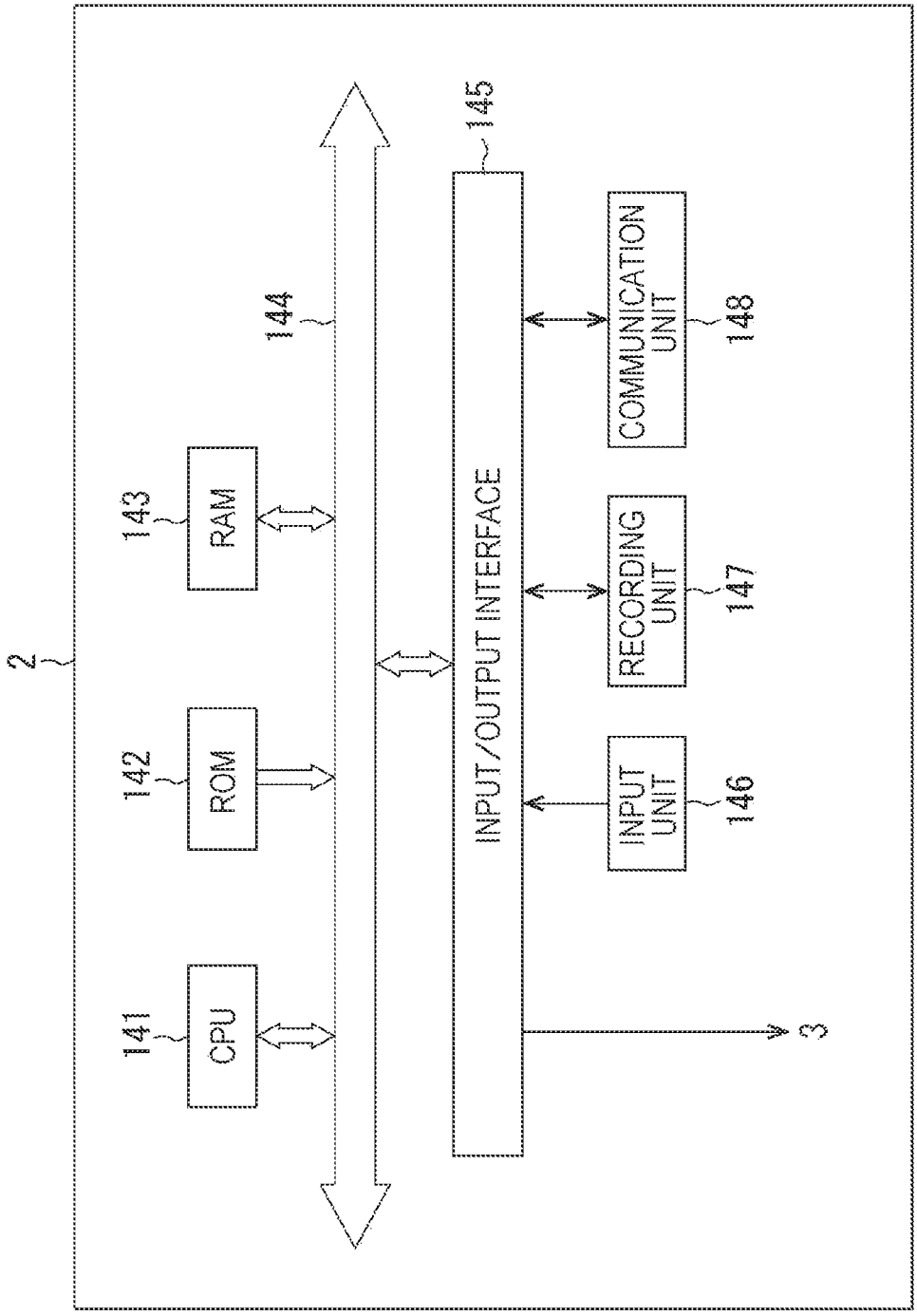

2
141
CPU
142
ROM
143
RAM
144
145
INPUT/OUTPUT INTERFACE
146
INPUT UNIT
147
RECORDING UNIT
148
COMMUNICATION UNIT
3

FIG. 15

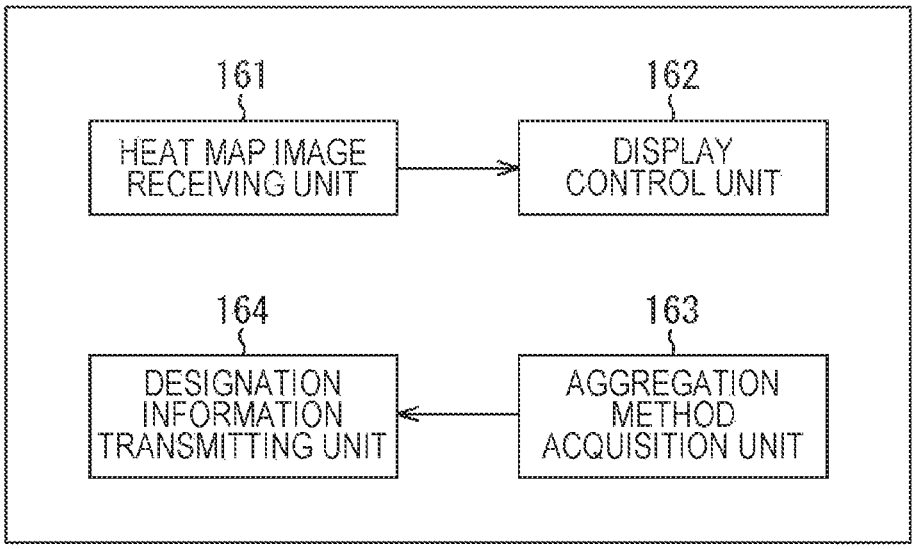

161
HEAT MAP IMAGE RECEIVING UNIT
162
DISPLAY CONTROL UNIT
164
DESIGNATION INFORMATION TRANSMITTING UNIT
163
AGGREGATION METHOD ACQUISITION UNIT

FIG. 16

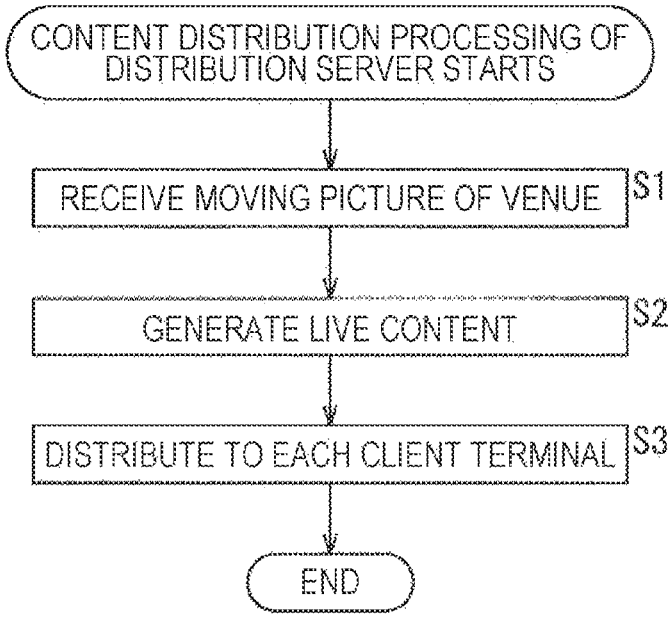

CONTENT DISTRIBUTION PROCESSING OF DISTRIBUTION SERVER STARTS
RECEIVE MOVING PICTURE OF VENUE
S1
GENERATE LIVE CONTENT
S2
DISTRIBUTE TO EACH CLIENT TERMINAL
S3
END

FIG. 17

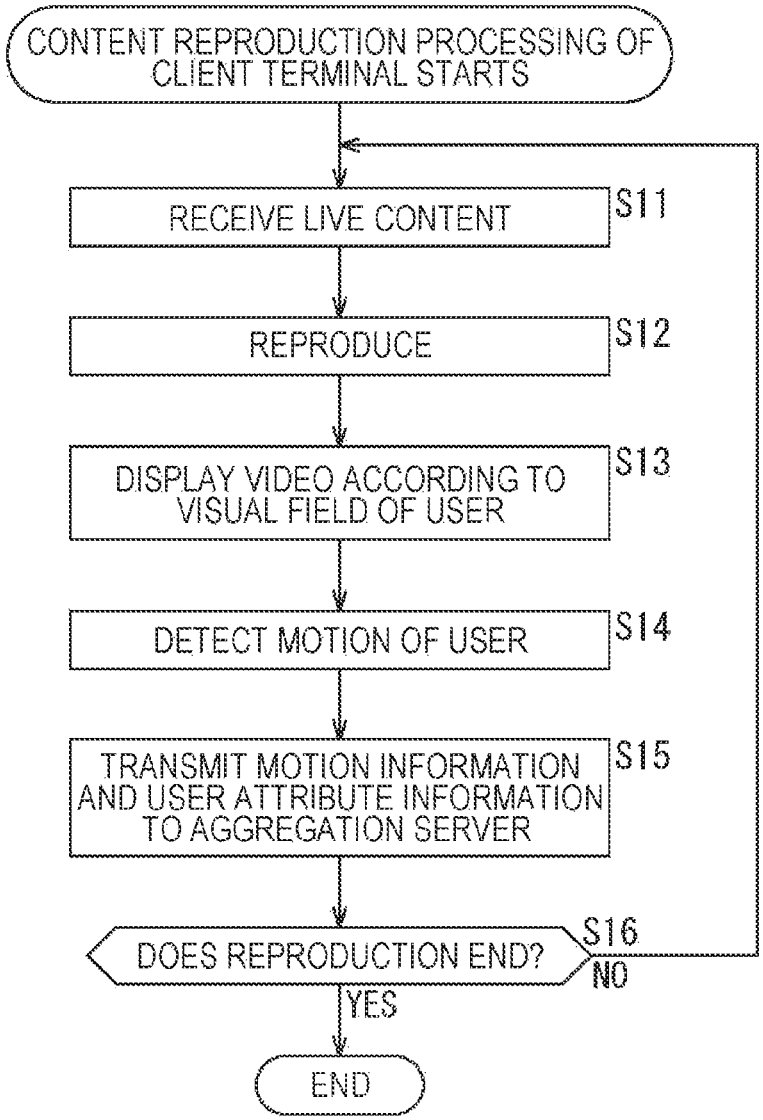

CONTENT REPRODUCTION PROCESSING OF CLIENT TERMINAL STARTS
RECEIVE LIVE CONTENT
S11
REPRODUCE
S12
DISPLAY VIDEO ACCORDING TO VISUAL FIELD OF USER
S13
DETECT MOTION OF USER
S14
TRANSMIT MOTION INFORMATION AND USER ATTRIBUTE INFORMATION TO AGGREGATION SERVER
S15
DOES REPRODUCTION END?
S16
NO
YES
END

FIG. 18

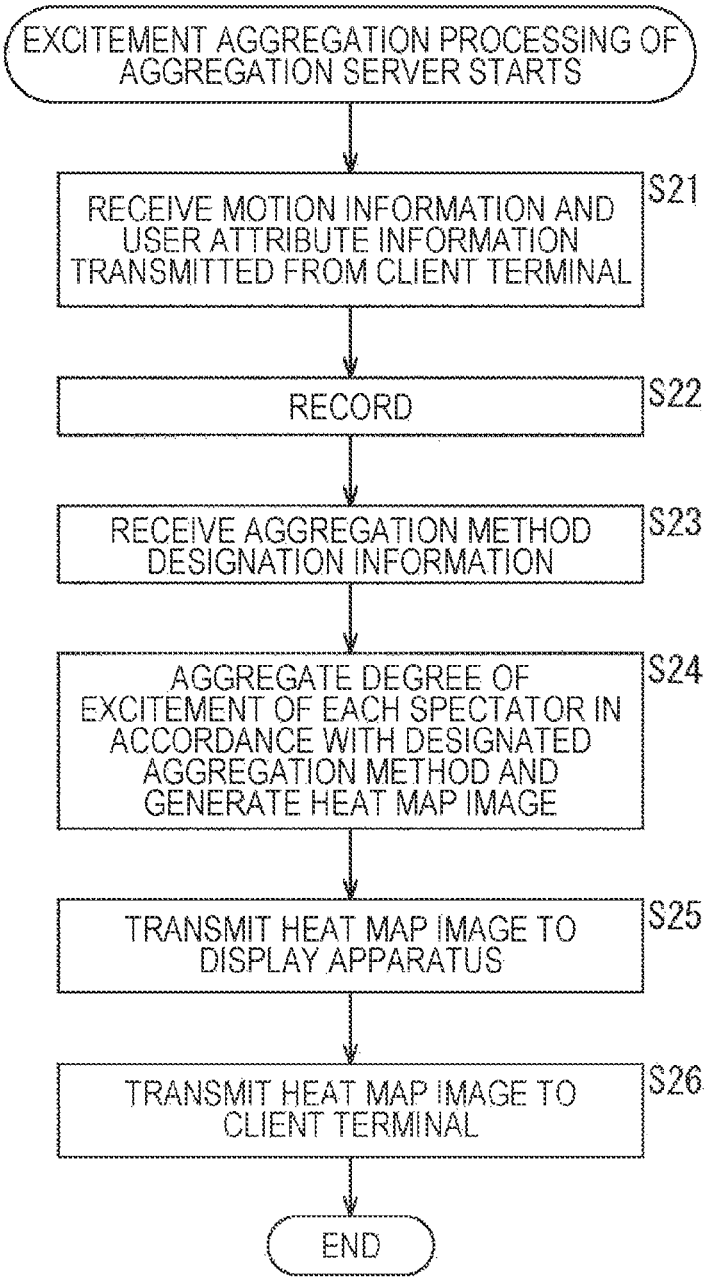

EXCITEMENT AGGREGATION PROCESSING OF AGGREGATION SERVER STARTS
RECEIVE MOTION INFORMATION AND USER ATTRIBUTE INFORMATION TRANSMITTED FROM CLIENT TERMINAL
S21
RECORD
S22
RECEIVE AGGREGATION METHOD DESIGNATION INFORMATION
S23
AGGREGATE DEGREE OF EXCITEMENT OF EACH SPECTATOR IN ACCORDANCE WITH DESIGNATED AGGREGATION METHOD AND GENERATE HEAT MAP IMAGE
S24
TRANSMIT HEAT MAP IMAGE TO DISPLAY APPARATUS
S25
TRANSMIT HEAT MAP IMAGE TO CLIENT TERMINAL
S26
END

FIG. 19

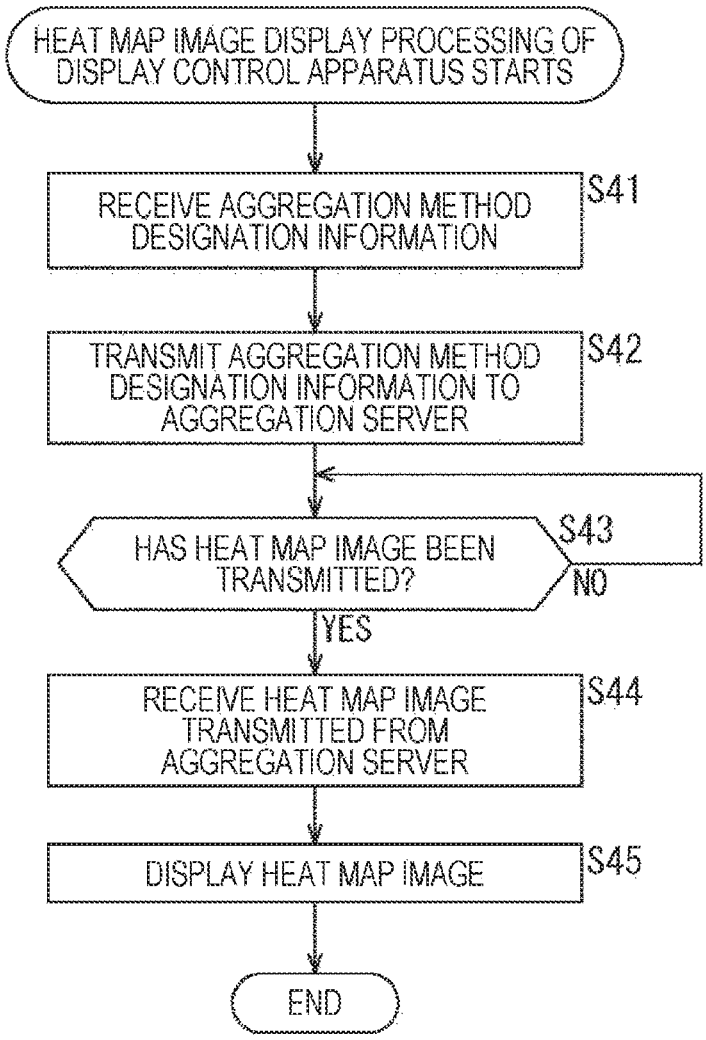

HEAT MAP IMAGE DISPLAY PROCESSING OF DISPLAY CONTROL APPARATUS STARTS
RECEIVE AGGREGATION METHOD DESIGNATION INFORMATION
S41
TRANSMIT AGGREGATION METHOD DESIGNATION INFORMATION TO AGGREGATION SERVER
S42
HAS HEAT MAP IMAGE BEEN TRANSMITTED?
S43
NO
YES
RECEIVE HEAT MAP IMAGE TRANSMITTED FROM AGGREGATION SERVER
S44
DISPLAY HEAT MAP IMAGE
S45
END

FIG. 20

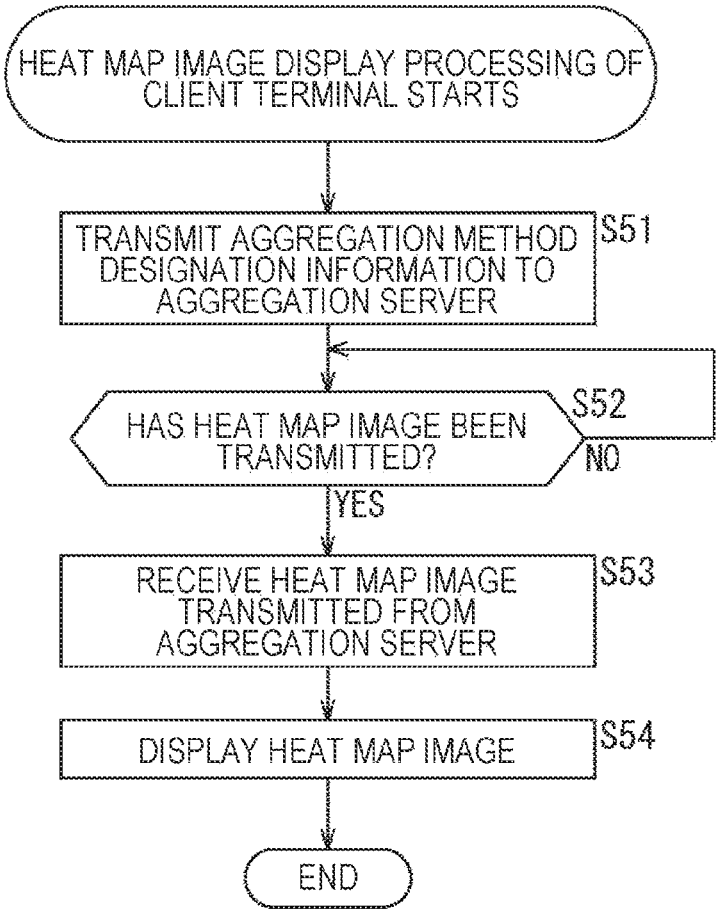

HEAT MAP IMAGE DISPLAY PROCESSING OF CLIENT TERMINAL STARTS
TRANSMIT AGGREGATION METHOD DESIGNATION INFORMATION TO AGGREGATION SERVER
S51
HAS HEAT MAP IMAGE BEEN TRANSMITTED?
S52
NO
YES
RECEIVE HEAT MAP IMAGE TRANSMITTED FROM AGGREGATION SERVER
S53
DISPLAY HEAT MAP IMAGE
S54
END

FIG. 21

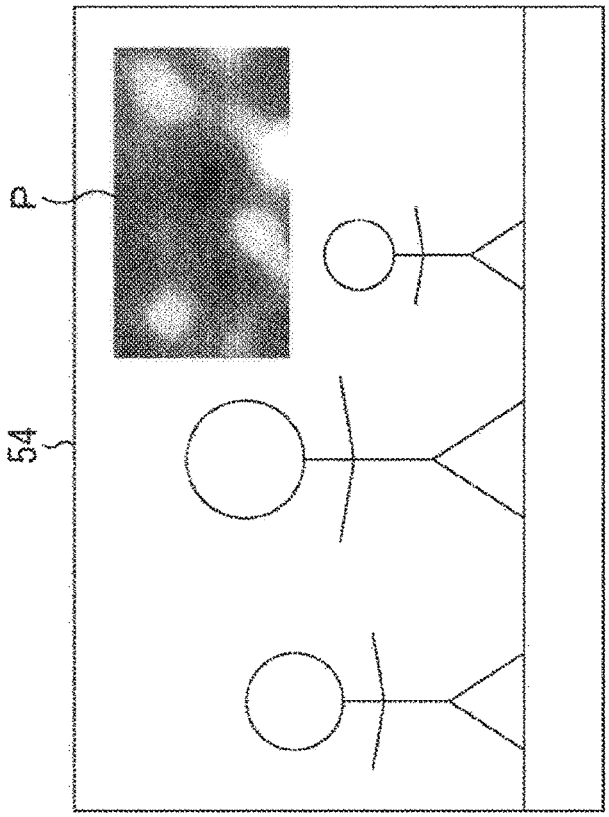


FIG. 22

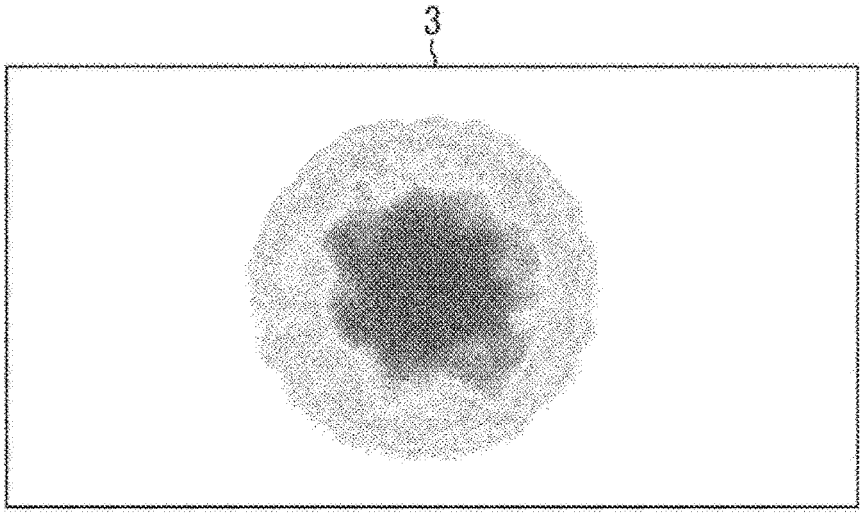


FIG. 23

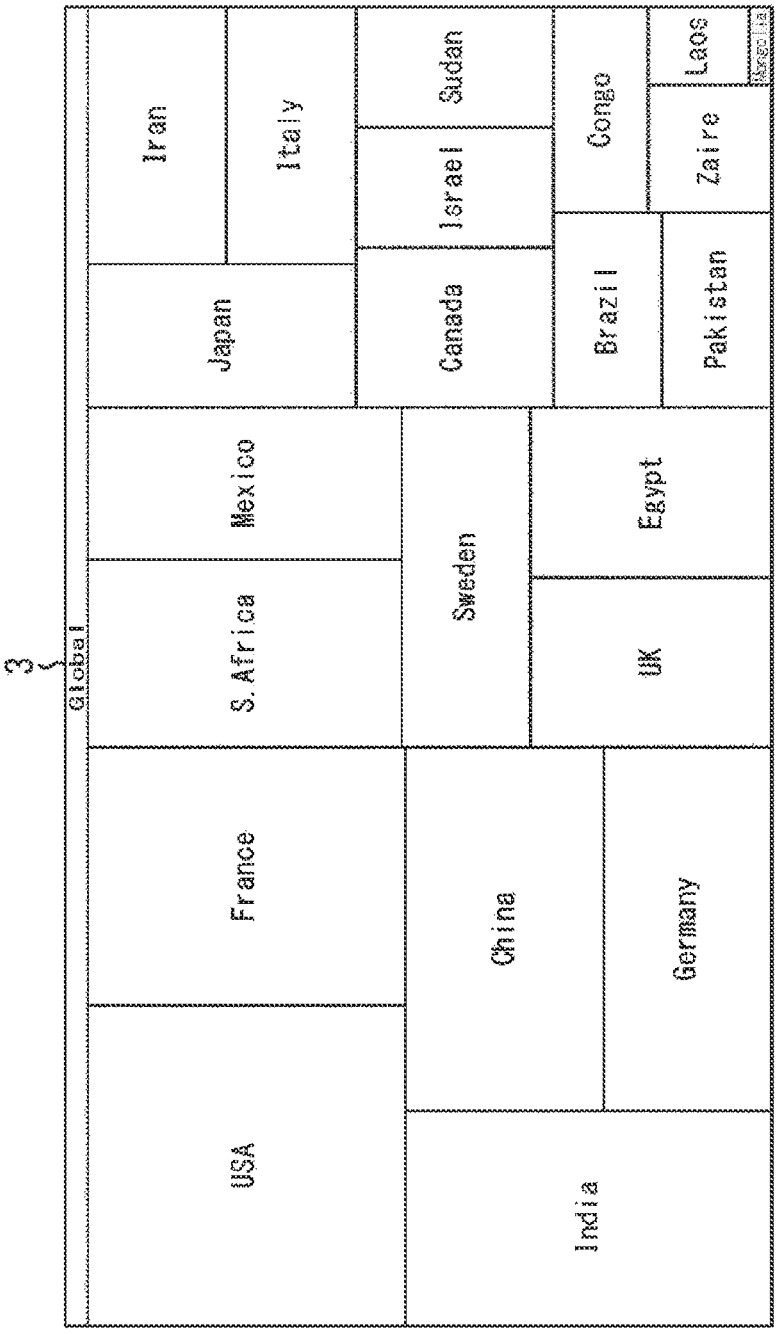

3
Global
USA
India
France
China
Germany
S.Africa
Sweden
UK
Mexico
Egypt
Japan
Canada
Brazil
Pakistan
Iran
Italy
Israel
Sudan
Congo
Zaire
Laos

FIG. 24

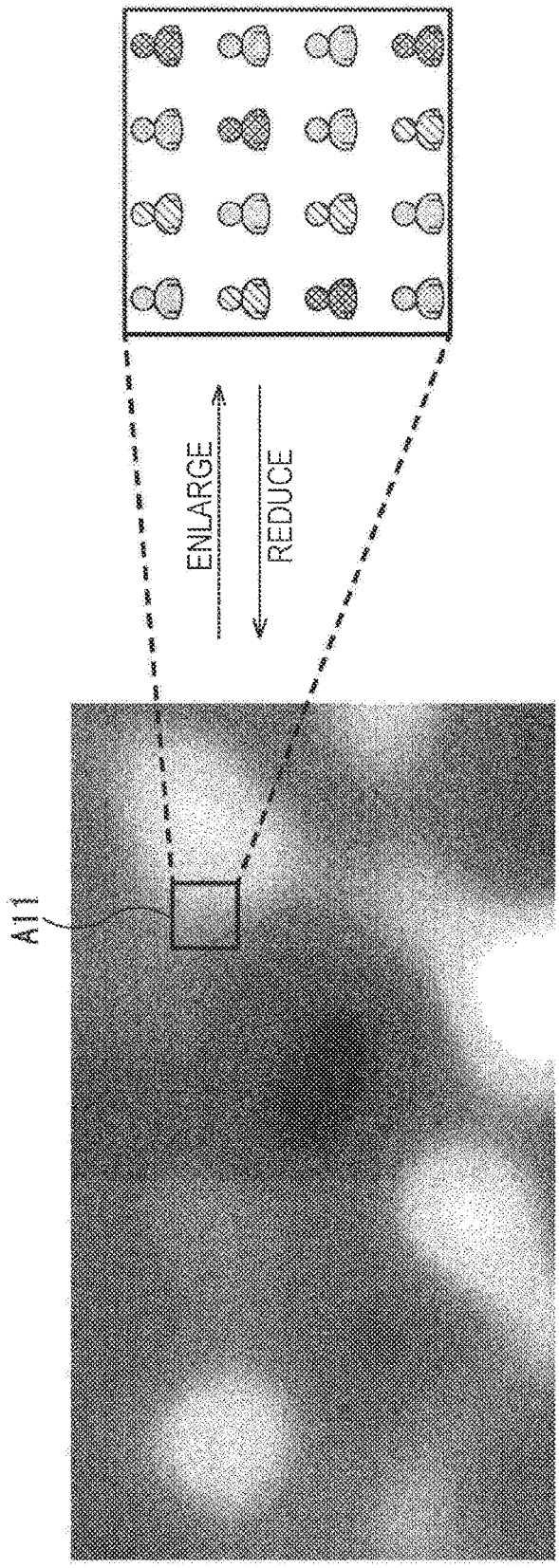


FIG. 25A

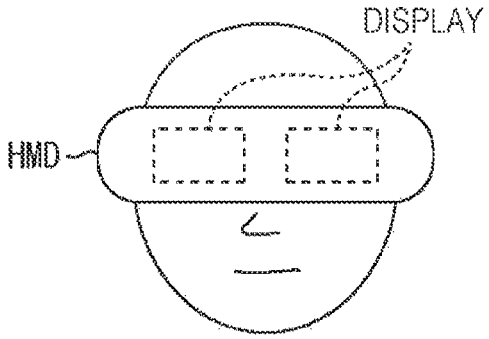


FIG. 25B

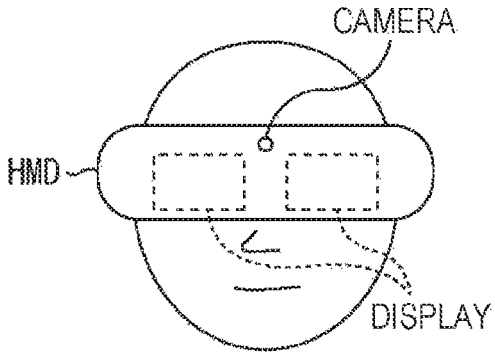
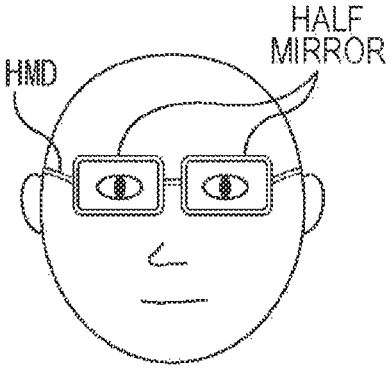


FIG. 25C



INFORMATION PROCESSING APPARATUS AND METHOD, DISPLAY CONTROL APPARATUS AND METHOD, REPRODUCING APPARATUS AND METHOD, AND INFORMATION PROCESSING SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation application of U.S. patent application Ser. No. 15/323,289, filed Dec. 30, 2016, which is a National Stage of PCT/JP2015/069382, filed Jul. 6, 2015, and claims the benefit of priority from prior Japanese Patent Application JP 2014-147597, filed Jul. 18, 2014, the entire content of which is hereby incorporated by reference

TECHNICAL FIELD

The present technology relates to an information processing apparatus and method, a display control apparatus and method, a reproducing apparatus and method, a program, and an information processing system, and in particular to an information processing apparatus and method, a display control apparatus and method, a reproducing apparatus and method, a program, and an information processing system that transmit a response of viewers acquired in a more natural way to a place where capturing of content is performed, enabling presentation in an easier-to-see way.

BACKGROUND ART

In recent years, various services to distribute moving pictures of concerts or sport games in real time have been provided. Viewers can watch content of the moving pictures distributed from a server by using their terminals such as PCs and smartphones.

There is also a technology to transmit a reaction of viewers who are watching content via the Internet to a venue and to present the reaction to spectators or the like who are in the venue.

CITATION LIST

Patent Document

Patent Document 1: Japanese Patent Application Laid-Open No. 2005-339479

Patent Document 2: Japanese Patent Application Laid-Open No. 2011-182109

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

In the above-described technology, the viewers of the content need to take, so to speak, active operations such as pushing buttons displayed on terminals used for watching the content in order to transmit their reaction to the venue. Therefore, sending the reaction causes an obstruction to being absorbed in watching the content.

The present technology has been made in view of such a situation and aims to transmit a response of the viewers acquired in a more natural way to a place where capturing of the content is performed, and to enable presentation in an easier-to-see way.

Solutions to Problems

An information processing apparatus according to a first aspect of the present technology includes: a receiving unit configured to receive motion information indicating a motion of a user who is watching video content and information indicating an attribute of the user transmitted from a reproducing apparatus that receives and reproduces the real time video content with a display range switched following the motion of the user who is a viewer within a range of a captured entire video; a generation unit configured to generate an excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and a transmitting unit configured to transmit data of the excitement image to a display control apparatus that causes a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image.

A display control apparatus according to a second aspect of the present technology includes: a receiving unit configured to receive motion information indicating a motion of a user who is watching video content and information indicating an attribute of the user transmitted from a reproducing apparatus that receives and reproduces the real time video content with a display range switched following the motion of the user who is a viewer within a range of a captured entire video, and to receive data of an excitement image transmitted from an information processing apparatus that generates the excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and a display control unit configured to cause a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image on the basis of the data of the excitement image.

A reproducing apparatus according to a third aspect of the present technology includes: a receiving unit configured to receive real time video content with a display range switched following a motion of a user who is a viewer within a range of a captured entire video; a reproducing unit configured to reproduce the video content; a detection unit configured to detect the motion of the user; a display unit configured to display the video of the display range according to the motion of the user; and a transmitting unit configured to transmit motion information indicating the motion of the user who is watching the video content to an information processing apparatus that aggregates the motion information together with information indicating an attribute of the user.

Effects of the Invention

The present technology enables transmission of the response of the viewers acquired in a more natural way to the place where capturing of the content is performed, and enables presentation in an easier-to-see way.

It is to be noted that effects described here may not necessarily be limited, and may be any effect described in the present disclosure.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a diagram illustrating a configuration example of an information processing system according to one embodiment of the present technology.

FIG. **2** is a plan view illustrating an example of an event venue.

FIG. **3** is a diagram illustrating an example of an angle of view of a video.

FIG. **4** is a diagram illustrating another example of the angle of view of the video.

FIGS. **5**A, **5**B, and **5**C are diagrams illustrating an example of the video.

FIG. **6** is a diagram illustrating an example of a visual field.

FIG. **7** is a diagram illustrating an example of a heat map image.

FIG. **8** is a block diagram illustrating a configuration example of an HMD.

FIG. **9** is a block diagram illustrating a functional configuration example of a control unit.

FIG. **10** is a diagram illustrating an example of information included in user attribute information.

FIG. **11** is a block diagram illustrating a configuration example of an aggregation server.

FIG. **12** is a block diagram illustrating a functional configuration example of the aggregation server.

FIG. **13** is a block diagram illustrating a functional configuration example of a distribution server.

FIG. **14** is a block diagram illustrating a configuration example of a display control apparatus.

FIG. **15** is a block diagram illustrating a functional configuration example of the display control apparatus.

FIG. **16** is a flowchart illustrating content distribution processing of the distribution server.

FIG. **17** is a flowchart illustrating reproduction processing of a client terminal.

FIG. **18** is a flowchart illustrating excitement aggregation processing of the aggregation server.

FIG. **19** is a flowchart illustrating heat map image display processing of the display control apparatus.

FIG. **20** is a flowchart illustrating the heat map image display processing of the client terminal.

FIG. **21** is a diagram illustrating a display example of a display.

FIG. **22** is a diagram illustrating another example of the heat map image.

FIG. **23** is a diagram illustrating an example of arrangement of information indicating a degree of excitement.

FIG. **24** is a diagram illustrating an example of switching of display of the heat map image.

FIGS. **25**A, **25**B, and **25**C are diagrams illustrating an example of a form of the HMD.

MODE FOR CARRYING OUT THE INVENTION

Hereinafter, a form for implementing the present technology will be described. The description is made in the following order.

1. Configuration of information processing system
2. Configuration of each device
3. Operation of each device
4. Example of heat map image
5. Variations

<Configuration of Information Processing System>

FIG. **1** is a diagram illustrating a configuration example of an information processing system according to one embodiment of the present technology.

The information processing system of FIG. **1** is a system that distributes moving pictures obtained by capturing concerts, sport games, and the like in real time.

The information processing system of FIG. **1** includes apparatuses on an event venue side where a concert or the like is held, a distribution server **11**, an aggregation server **12**, and head mounted displays (HMDs) **21** to **24** used by viewers of live content.

While FIG. **1** illustrates four HMDs as client terminals, more client terminals may be provided. It is also possible that the distribution server **11** and the aggregation server **12** are installed in the event venue. In addition, it is also possible to implement functions of the distribution server **11** and the aggregation server **12** with one server. Respective apparatuses are connected via a network such as the Internet.

A capturing control apparatus **1**, a display control apparatus **2**, and a large display **3** are provided in the event venue. In the example of FIG. **1**, a concert is held in the event venue, and three persons as performers and spectators of the concert are in the event venue. The large display **3** is installed at a position both the performers and the spectators can see.

The capturing control apparatus **1** controls cameras installed in the event venue and controls capturing of the concert. The capturing control apparatus **1** transmits a captured moving picture to the distribution server **11** over the network.

The distribution server **11** generates live content for distribution on the basis of the moving picture transmitted from the capturing control apparatus **1**, and then transmits the live content to the HMDs **21** to **24**. The live content transmitted from the distribution server **11** is, for example, content including videos captured at a plurality of positions with an angle of view in at least one of a horizontal direction and a vertical direction being 360 degrees.

For example, a user of the HMD **21** who receives the live content transmitted from the distribution server **11** can select a visual point and watch the video from the selected visual point while changing a visual field. The live content transmitted from the distribution server **11** is so-called free visual point content with a changeable visual point.

Each of the HMDs **21** to **24** is equipped with a sensor for head tracking, such as an acceleration sensor and an angular velocity sensor. Each of the HMDs **21** to **24** detects a posture of a head of the user wearing each of the HMDs **21** to **24**, and then switches a display range of the video according to a direction of a line of sight guessed from the posture of the head. Of the entire angle of view of 360 degrees, the user will see a certain range of the video that is in a direction in which the user faces.

Here, "the visual point" is a standpoint of the user who sees an object. Also, "the visual field" is a range the user sees, and corresponds to the range of video displayed on a display (display range). "The line of sight" is a direction of the user's visual field, and corresponds to a direction of the display range of the video on the basis of a predetermined direction in capturing space.

FIG. **2** is a plan view illustrating an example of the event venue.

A stage #1 is provided in the event venue, and a spectator floor #2 is provided ahead of the stage #1 (in a lower part of FIG. **2**). Three singers of persons H**1**, H**2**, and H**3** are on the stage #1. In addition, a lot of spectators are in the spectator floor #2, behind which is installed the large display **3**. A subject is a scene of the entire event venue.

Positions P**1** to P**3** are capturing positions of videos. At each of the positions P**1** to P**3** is installed a camera capable of capturing a video with an angle of view in at least one of the horizontal direction and vertical direction being 360 degrees. By installation of a plurality of cameras with

different capturing ranges at respective capturing positions and composition of the videos captured by the cameras, a video with the capturing positions of the positions P1 to P3 and the angle of view of 360 degrees may be generated.

Hollow arrows A1 to A3 indicate reference directions at the positions of the positions P1 to P3, respectively. In the example of FIG. 2, the direction of the stage #1 is the reference direction.

FIG. 3 is a diagram illustrating an example of the angle of view of the videos to be captured at the positions P1 to P3.

For example, when a wide-angle lens is pointed at right above at each of the positions P1 to P3 and capturing is performed, as illustrated in FIG. 3, the video of a half celestial sphere range is captured in which an optical axis L1 illustrated in alternate long and short dash line crosses a zenith. The angle of view of FIG. 3 is an angle of view of 360 degrees in the horizontal direction and 180 degrees in the vertical direction.

As illustrated in FIG. 4, the video of an entire celestial sphere range with the angle of view in both horizontal direction and vertical direction of 360 degrees may be captured at each of the positions P1 to P3. Here, when represented in latitude/longitude using equidistant cylindrical projection, the video of the entire celestial sphere range may be represented as 360 degrees in the horizontal direction and 180 degrees in the vertical direction; here, in order to distinguish from the half celestial sphere range of FIG. 3, the angle of view in both horizontal direction and vertical direction are 360 degrees.

For convenience of description, the following describes a case where the video captured at each of the positions P1 to P3 is the video of the half celestial sphere range illustrated in FIG. 3.

FIGS. 5A, 5B, and 5C are diagrams illustrating examples of the videos captured at the positions P1 to P3, respectively.

The half celestial spheres of FIGS. 5A, 5B, and 5C indicate the entire videos of one frame of the moving pictures captured at the positions P1 to P3, respectively.

As illustrated in FIG. 5A, at the position P1, the moving picture is captured in which the person H1 is reflected large in the direction of the stage #1 indicated by the hollow arrow A1, and the person H2 is reflected smaller than the person H1 on a right side of the person H1. The person H3 will be reflected still smaller on a right side of the person H2. The spectators who face the direction of the stage #1 are reflected in the opposite direction of the stage #1.

As illustrated in FIG. 5B, at the position P2, the moving picture is captured in which the person H3 is reflected large in the direction of the stage #1 indicated by the hollow arrow A2, and the person H2 is reflected smaller than the person H3 on a left side of the person H3. The person H1 will be reflected still smaller on a left side of the person H2. The spectators who face the direction of the stage #1 are reflected in the opposite direction of the stage #1.

As illustrated in FIG. 5C, at the position P3, the moving picture is captured in which the entire stage #1 is reflected on a far side in the direction indicated by the hollow arrow A3, and on a near side thereof, back sight of the spectators who face the direction of the stage #1 is reflected. Although illustration is omitted, the large display 3 is reflected on an opposite side of the spectators.

FIG. 6 is a diagram illustrating an example of the visual field at the position P1. A range of a frame F1 illustrated in dashed line on a surface of a sphere of FIG. 6 indicates, for example, the display range of the HMD 21, that is, the visual field of the user of the HMD 21. In the HMD 21, an image within the range indicated by the frame F1 is cut out from each frame and is displayed as a moving picture.

In response to the user moving the head, the frame F1 moves as indicated by arrows, and the range displayed on the display of the HMD 21 is also switched. A shape and size of the frame indicating the range of the visual field will change according to an aspect ratio and viewing angle of the display included in each client terminal. The visual field of the user is specified by a position (coordinate) of the position P1 in the capturing space, the direction of the frame F1 with respect to the reference direction, and the angle of view of the frame F1.

It is to be noted that the description here assumes that the number of visual points is three; however, the number of visual points may be one and may be four or more. The live content distributed from the distribution server 11 includes a video stream of the video captured from one or more visual points. According to the visual point selected by the user, the video stream reproduced in the client terminal is switched.

Also, content of full free visual point generated by composition of videos captured at a plurality of positions may be distributed from the distribution server 11. The content of full free visual point is content that allows selection of any position in the capturing space as the visual point.

Returning to description of FIG. 1, the HMDs 21 to 24 each reproduce the live content transmitted from the distribution server 11. The users of the HMDs 21 to 24 who are provided with the live content can also see the scene almost identical to the scene the spectators in the event venue see.

The HMDs 21 to 24 each reproduce the live content and then cause a built-in display to display the video of the visual point selected by the user. The HMDs 21 to 24 are each a so-called immersive HMD, and project the video in front of eyes of the user who wears a body.

The HMDs 21 to 24 each detect a posture of the user's head during reproduction of the live content, and switch the display range of the video according to the posture of the head. As described with reference to FIG. 6, for example, when the user turns face rightward, the HMDs 21 to 24 each move the display range of the video rightward while keeping the position of the visual point as it is, and when the user turns face leftward, the HMDs 21 to 24 each move the display range of the video leftward while keeping the position of the visual point as it is.

In addition, during reproduction of the live content, the HMDs 21 to 24 each detect a motion of the user on the basis of output from the acceleration sensor or angular velocity sensor. For example, the HMDs 21 to 24 each detect a plurality of types of user motion, such as a degree to which the user is swinging the head up and down, a degree to which the user is swaying the body, and whether the user is raising an arm.

The HMDs 21 to 24 each transmit motion information indicating the motion of the user who is watching the live content to the aggregation server 12 together with information indicating an attribute of the user. Vital signs including a pulse, a heart rate, a body temperature, and other signs of the user who is watching the live content detected by a sensor the user wears on the body is also added to the motion information. As will be described later, the user attribute includes rough positional information on the user, such as a position in district unit.

It can be said that the motion of the user while watching the live content indicates a degree of excitement of the user. Thus, the information processing system of FIG. 1 will

acquire the degree of excitement of the user in a natural way without causing the user to perform active operations such as operating a button.

The aggregation server **12** receives the motion information and the user attribute information transmitted from the HMDs **21** to **24**, and then aggregates the degree of excitement, for example, in accordance with an aggregation method designated by the performers who are in the event venue. For example, conditions such as a method for determining the degree of excitement based on motion and a method of arrangement of information on each degree of excitement when visualizing the excitement information are designated as the aggregation method.

The aggregation server **12** determines the degree of excitement of the users of the HMDs **21** to **24**, that is, the degree of excitement of the spectators who are at distant location, on the basis of the motion information of the users of the HMDs **21** to **24**.

The aggregation server **12** generates a heat map image that visualizes the degree of excitement of all the spectators who are at distant location, and then transmits data of the heat map image to the display control apparatus **2** installed in the event venue. The heat map image is an image formed by arranging information that visually indicates the degree of excitement of each user at a position according to the attribute of each user.

The display control apparatus **2** receives the data transmitted from the aggregation server **12** and then causes the large display **3** to display the heat map image.

FIG. **7** is a diagram illustrating an example of the heat map image. In the example of FIG. **7**, the degree of excitement of each spectator who is at distant location is indicated by color. For example, when the performers designate determination of the degree of excitement on the basis of "intensity of the head motion", higher degree of excitement is set and color with higher saturation and brightness is assigned to the spectator with higher-intensity head motion.

The heat map image of FIG. **7** is an image formed by arranging images of predetermined color indicating excitement of respective spectators at positions corresponding to location information as the attributes of respective spectators.

For example, a region A**1** of FIG. **7** is a region assigned to the user of the HMD **21** who is a spectator watching the live content in the Kanto district in Japan. The color of the region A**1** indicates the degree of excitement of the user of the HMD **21**. Also, a region A**2** close to the region A**1** is a region assigned to the user of the HMD **22** who is a spectator similarly watching the live content in the Kanto district. The color of the region A**2** indicates the degree of excitement of the user of the HMD **22**.

Also, a region A**3** formed in a lower part is a region assigned to the user of the HMD **23** who is a spectator watching the live content in the Kyusyu district in Japan. The color of the region A**3** indicates the degree of excitement of the user of the HMD **23**. Also, a region A**4** formed in an upper right part is a region assigned to the user of the HMD **24** who is a spectator watching the live content in the Hokkaido district in Japan. The color of the region A**4** indicates the degree of excitement of the user of the HMD **24**.

The region assigned to each user may be one pixel of the large display **3** and may be a region including a plurality of pixels. Also, a shape of the region can be not only a square but also any shape such as a circle.

Thus, since the information indicating the degree of excitement of the spectators who are at distant location is displayed, the performers who are in the event venue can realize the excitement of the spectators who are at distant location, and can improve motivation.

Also, since the information indicating the excitement of the spectators who are at distant location is arranged and displayed at the positions according to the attribute of each spectator, the performers can intuitively check spectators with which attribute are excited and spectators with which attribute are not. In the example of FIG. **7**, the performers can intuitively check in which district of Japan the users are excited.

Also, since the performers can designate on the basis of what kind of motion to determine the degree of excitement, the performers can request the spectators who are at distant location to perform a predetermined motion, and can check how much the spectators react to the request. The performers can sequentially make an improvised request that, for example, the spectators of each area should perform a motion such as swaying the body, and can obtain a sense of togetherness with the spectators who are at distant location through such a two-way interaction.

Also, the spectators who are in the event venue can share the excitement with the spectators who are at distant location.

Meanwhile, the spectators who are at distant location can check the excitement of the spectators who are at distant location including themselves by changing the line of sight or the like and watching display on the large display **3** inside the live content. In addition, the spectators who are at distant location can obtain experience with realistic feeling by confirming that their excitement is conveyed to the performers and the spectators who are in the event venue.

It is to be noted that the data of the heat map image is also transmitted from the aggregation server **12** to the HMDs **21** to **24** as appropriate. In the HMDs **21** to **24**, the heat map image is displayed superimposed on the video of the live content.

A series of processing steps of displaying the heat map image as described above will be described later.

<Configuration of Each Device>

Configuration of HMD

FIG. **8** is a block diagram illustrating a configuration example of the HMD **21**.

The HMD **21** includes a communication unit **52**, a sensor **53**, a display **54**, an operation unit **55**, a speaker **56**, and a storage unit **57**, which are connected to a control unit **51**.

The control unit **51** includes elements such as a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM). The control unit **51** executes a predetermined program and controls an overall operation of the HMD **21**.

The communication unit **52** communicates with the distribution server **11** and the aggregation server **12**, for example, wirelessly. The communication unit **52** receives the live content transmitted from the distribution server **11** and then outputs the live content to the control unit **51**. In addition, the communication unit **52** transmits the motion information and the user attribute information supplied from the control unit **51** to the aggregation server **12**.

The sensor **53** includes a global positioning system (GPS) sensor, an angular velocity sensor, an acceleration sensor, and other sensors. The sensor **53** performs positioning and detection of an angular velocity and acceleration during reproduction of the live content, and then outputs sensor data to the control unit **51**.

The display **54** includes an LCD, an organic EL display, or the like, and displays the video of the live content in accordance with control performed by the control unit **51**.

The operation unit **55** includes operation buttons and the like provided on an enclosure surface of the HMD **21**. Selection of the live content, selection of the visual point, and the like are performed using the operation unit **55**.

The speaker **56** outputs audio on the basis of audio data contained in the live content supplied from the control unit **51** during reproduction of the live content.

The storage unit **57** includes a flash memory or a memory card inserted into a card slot provided in the enclosure.

The HMDs **22** to **24** each have the configuration identical to the configuration of the HMD **21**. The following description cites the configuration of FIG. **8** as the configuration of the HMDs **22** to **24** as appropriate.

FIG. **9** is a block diagram illustrating a configuration example of the control unit **51**. At least part of functional units illustrated in FIG. **9** is implemented by a CPU of the control unit **51** executing a predetermined program. As illustrated in FIG. **9**, in the control unit **51**, a live content receiving unit **91**, a reproducing unit **92**, a display control unit **93**, a motion detection unit **94**, a motion information transmitting unit **95**, and an attribute information management unit **96** are implemented. The sensor data that is output from the sensor **53** is input into the display control unit **93** and the motion detection unit **94**.

The live content receiving unit **91** controls the communication unit **52** and receives the live content transmitted from the distribution server **11**. The live content receiving unit **91** outputs the received live content to the reproducing unit **92**.

The reproducing unit **92** reproduces the live content supplied from the live content receiving unit **91**. The reproducing unit **92** decodes, for example, the video stream of the video of the visual point selected by the user contained in the live content, and then outputs data obtained by decoding the video stream to the display control unit **93**.

The display control unit **93** causes the display **54** to display the video of the predetermined visual field of the live content on the basis of the data supplied from the reproducing unit **92**. In addition, during reproduction of the live content, the display control unit **93** identifies the visual field of the user on the basis of the sensor data, such as an angular velocity and acceleration, and then switches the display range of the video. Information indicating the visual field of the user is supplied to the attribute information management unit **96**.

The motion detection unit **94** detects a plurality of types of user motion during reproduction of the live content on the basis of the sensor data such as an angular velocity and acceleration. The motion detection unit **94** outputs the motion information indicating the detected motion to the motion information transmitting unit **95**. Vital signs including a pulse, a heart rate, a body temperature, and other signs are added to the motion information.

The motion information transmitting unit **95** controls the communication unit **52** and transmits the motion information supplied from the motion detection unit **94** and the user attribute information read from the attribute information management unit **96** to the aggregation server **12**. Transmission of the motion information and the user attribute information is repeatedly performed, for example, during reproduction of the live content. The attribute information management unit **96** manages the user attribute information and outputs the user attribute information to the motion information transmitting unit **95** as appropriate.

FIG. **10** is a diagram illustrating an example of information included in the user attribute information.

The user attribute information includes location information, favorite information, and visual field information.

The location information is information indicating rough location, such as a district unit. The location information may be acquired on the basis of positioning results performed by the GPS sensor that constitutes the sensor **53**, and may be input by the user.

The favorite information is information indicating a favorite person reflected in the live content the user is watching. The favorite information may be selected from a list of performers at a time of starting watching of the live content, or the favorite information may be specified by the attribute information management unit **96** on the basis of the visual field of the user. In this case, for example, the attribute information management unit **96** identifies a time period and a position of each performer reflected in the visual field of the user. The attribute information management unit **96** then specifies the performer who is reflected for a longer time in the visual field of the user and reflected at a position close to a center of the visual field as the favorite person of the user.

The visual field information is information indicating the visual field of the user identified on the basis of the sensor data such as an angular velocity and acceleration. As described above, the visual field of the user is identified by using a position of the visual point, a direction of the line of sight, and the angle of view of the display **54**. Where in the event venue the user sees is identified by using the visual field information.

The user attribute information can include at least one of various types of information, such as the user's national origin, hobby, area of expertise, gender, and user ID. The user attribute information includes at least one of a plurality of types of information.

Configuration of Server

FIG. **11** is a block diagram illustrating a configuration example of the aggregation server **12**.

A CPU **101**, a ROM **102**, and a RAM **103** are connected to one another via a bus **104**. An input/output interface **105** is also connected to the bus **104**. A display **106** and an input unit **107** are connected to the input/output interface **105**. The input unit **107** is a keyboard, a mouse, or the like, and is used by an administrator of the aggregation server **12**.

In addition, a recording unit **108** including a hard disk, a nonvolatile memory, or the like, and a communication unit **109**, which is a network interface and communicates with other devices via the network, are connected to the input/output interface **105**. A drive **110** that drives a removable medium **111** is also connected to the input/output interface **105**.

FIG. **12** is a block diagram illustrating a functional configuration example of the aggregation server **12**.

At least part of functional units illustrated in FIG. **12** is implemented by the CPU **101** executing a predetermined program. As illustrated in FIG. **12**, in the aggregation server **12**, a motion information receiving unit **121**, a motion information recording unit **122**, an excitement aggregation unit **123**, a designation information receiving unit **124**, and a heat map image transmitting unit **125** are implemented.

The motion information receiving unit **121** controls the communication unit **109** and receives the motion information and the user attribute information transmitted from the HMDs **21** to **24**. The motion information receiving unit **121**

causes the motion information recording unit **122** to record the received motion information and the user attribute information.

The motion information recording unit **122** records the motion information and the user attribute information. The motion information and the user attribute information recorded in the motion information recording unit **122** are read by the excitement aggregation unit **123** as appropriate.

The excitement aggregation unit **123** reads the motion information and the user attribute information from the motion information recording unit **122**. The excitement aggregation unit **123** then aggregates the degree of excitement of the spectators who are at distant location in accordance with the aggregation method designated by the performers who are in the event venue. The vital signs added to the motion information are also used for determining the degree of excitement as appropriate.

As described above, the method for determining the degree of excitement based on the motion, the method of arrangement of the information on each degree of excitement when visualizing the excitement information, and the like are designated by the performers. The aggregation method designated by the performers is indicated by aggregation method designation information supplied from the designation information receiving unit **124**.

For example, when the method for determining the degree of excitement is designated on the basis of whether the head is shaken intensely, the excitement aggregation unit **123** determines the degree of excitement of each user on the basis of the degree to which the user is shaking the head up and down which is indicated using the motion information.

In addition, when the method for determining the degree of excitement is designated on the basis of whether the user is in rhythm, the excitement aggregation unit **123** determines the degree of excitement of each user on the basis of the degree to which the user is swaying the body which is indicated using the motion information.

Specifically, the excitement aggregation unit **123** applies Fourier transform or wavelet transform to information indicating the motion of the user head or the motion of the user body to perform frequency conversion. The excitement aggregation unit **123** determines the degree of excitement of each user by applying calculation using a predetermined function, such as an identity function, step function, and sigmoid function, to a value obtained by performing frequency conversion and a value such as a heart rate, body temperature, and the like indicated by the vital signs.

The excitement aggregation unit **123** generates the heat map image by arranging the information that visually indicates the degree of excitement of each user determined in this way by the method designated by the performers who are in the event venue with reference to the user attribute information.

For example, the excitement aggregation unit **123** divides the information that visually indicates the degree of excitement of each user into groups each of which includes the degrees of excitement of the users of an identical area. The excitement aggregation unit **123** then arranges each group together on the heat map image. The location information included in the user attribute information indicates in which area each user is.

Thus, the excitement aggregation unit **123** visualizes the excitement information on the spectators who are at distant location, and then outputs the data of the heat map image to the heat map image transmitting unit **125**.

The designation information receiving unit **124** controls the communication unit **109** and receives the aggregation method designation information transmitted from the display control apparatus **2**. The designation information receiving unit **124** outputs the received aggregation method designation information to the excitement aggregation unit **123**.

The heat map image transmitting unit **125** controls the communication unit **109** and transmits the data of the heat map image supplied from the excitement aggregation unit **123** to the display control apparatus **2**. The heat map image transmitting unit **125** also transmits the data of the heat map image to the HMDs **21** to **24** as appropriate.

It is to be noted that the distribution server **11** also has the configuration identical to the configuration of the aggregation server **12** illustrated in FIG. **11**. The following description cites the configuration of FIG. **11** as the configuration of the distribution server **11** as appropriate.

FIG. **13** is a block diagram illustrating a functional configuration example of the distribution server **11**.

At least part of functional units illustrated in FIG. **13** is implemented by the CPU **101** of the distribution server **11** (FIG. **11**) executing a predetermined program. As illustrated in FIG. **13**, in the distribution server **11**, a moving picture acquisition unit **131**, a live content generation unit **132**, and a distribution unit **133** are implemented.

The moving picture acquisition unit **131** controls the communication unit **109** and receives the moving picture of each visual point transmitted from the capturing control apparatus **1**. The moving picture acquisition unit **131** outputs data of the received moving picture to the live content generation unit **132**.

The live content generation unit **132** generates the live content for distribution on the basis of the data of the moving picture supplied from the moving picture acquisition unit **131**, and then outputs the live content for distribution to the distribution unit **133**.

The distribution unit **133** controls the communication unit **109** and distributes the live content generated by the live content generation unit **132** to the HMDs **21** to **24**.

Configuration of Display Control Apparatus

FIG. **14** is a block diagram illustrating a configuration example of the display control apparatus **2**.

A CPU **141**, a ROM **142**, and a RAM **143** are connected to one another via a bus **144**. An input/output interface **145** is also connected to the bus **144**. The large display **3** is connected to the input/output interface **145**. In addition, an input unit **146** operated by an administrator of the display control apparatus **2**, such as a keyboard and a mouse, is connected to the input/output interface **145**.

A recording unit **147** including a hard disk, a nonvolatile memory, and the like, and a communication unit **148** that communicates with other devices via a network are also connected to the input/output interface **145**.

FIG. **15** is a block diagram illustrating a functional configuration example of the display control apparatus **2**.

At least part of functional units illustrated in FIG. **15** is implemented by the CPU **141** executing a predetermined program. As illustrated in FIG. **15**, in the display control apparatus **2**, a heat map image receiving unit **161**, a display control unit **162**, an aggregation method acquisition unit **163**, and a designation information transmitting unit **164** are implemented.

The heat map image receiving unit **161** controls the communication unit **148** and receives the data of the heat map image transmitted from the aggregation server **12**. The heat map image receiving unit **161** outputs the data of the heat map image to the display control unit **162**.

The display control unit **162** causes the large display **3** to display the heat map image on the basis of the data supplied from the heat map image receiving unit **161**.

The aggregation method acquisition unit **163** controls the communication unit **148** and communicates with, for example, the portable terminals the performers have. The aggregation method acquisition unit **163** receives the aggregation method designation information transmitted from the portable terminals, the aggregation method designation information designating the aggregation method of the degree of excitement of the users who are at distant location. The aggregation method acquisition unit **163** outputs the received aggregation method designation information to the designation information transmitting unit **164**. The designation of the aggregation method may not be performed by the performers but may be performed by an operator of the concert.

The designation information transmitting unit **164** controls the communication unit **148** and transmits the aggregation method designation information supplied from the aggregation method acquisition unit **163** to the aggregation server **12**.

<Operation of Each Device>

Here, an operation of each device having the aforementioned configuration will be described.

First, with reference to a flowchart of FIG. **16**, processing of the distribution server **11** that distributes the live content will be described.

The processing of FIG. **16** starts when the concert starts in the event venue and the moving picture of the event venue is transmitted from the capturing control apparatus **1**. In step S**1**, the moving picture acquisition unit **131** receives the moving picture of each visual point transmitted from the capturing control apparatus **1**.

In step S**2**, the live content generation unit **132** generates the live content for distribution on the basis of the moving picture received by the moving picture acquisition unit **131**.

In step S**3**, the distribution unit **133** distributes the live content generated by the live content generation unit **132** to the HMDs **21** to **24**. When the distribution of the live content ends, the distribution unit **133** ends the processing.

Next, with reference to a flowchart of FIG. **17**, processing of the client terminal that reproduces the live content will be described. While the description is made here on an assumption that the HMD **21** performs the processing, similar processing is also performed in the HMDs **22** to **24**.

In step S**11**, the live content receiving unit **91** receives the live content transmitted from the distribution server **11**.

In step S**12**, the reproducing unit **92** reproduces the live content received by the live content receiving unit **91**.

In step S**13**, the display control unit **93** causes the display **54** to display the video according to the visual field of the user on the basis of the data obtained by decoding the video stream of the video of a predetermined visual point. In addition, the display control unit **93** identifies the visual field of the user on the basis of the sensor data, and then switches the display range of the video. The visual field information indicating the visual field of the user is included in the user attribute information and is managed by the attribute information management unit **96**.

In step S**14**, the motion detection unit **94** detects a plurality of types motion of the user on the basis of the sensor data.

In step S**15**, the motion information transmitting unit **95** adds the vital signs to the motion information indicating the motion of the user detected by the motion detection unit **94**. The motion information transmitting unit **95** then transmits the motion information and the vital signs to the aggregation server **12** together with the user attribute information read from the attribute information management unit **96**.

In step S**16**, the reproducing unit **92** determines whether the reproduction ends. When the reproducing unit **92** determines in step S**16** that the reproduction does not end, the processing returns to step S**11**, and the subsequent processing will be performed. On the other hand, when the reproducing unit **92** determines in step S**16** that the reproduction ends for a reason that the live content has been reproduced to the end or other reasons, the reproducing unit **92** ends the processing.

Next, with reference to a flowchart of FIG. **18**, processing of the aggregation server **12** that aggregates the excitement of the spectators who are at distant location will be described.

In step S**21**, the motion information receiving unit **121** receives the motion information and the user attribute information transmitted from the HMDs **21** to **24**.

In step S**22**, the motion information recording unit **122** associates the motion information with the user attribute information, and records the motion information and the user attribute information

In step S**23**, the designation information receiving unit **124** receives the aggregation method designation information transmitted from the display control apparatus **2**.

In step S**24**, the excitement aggregation unit **123** aggregates the degree of excitement of the spectators who are at distant location in accordance with the aggregation method designated by the performers. The excitement aggregation unit **123** then generates the heat map image.

In step S**25**, the heat map image transmitting unit **125** transmits the data of the heat map image to the display control apparatus **2**.

In step S**26**, the heat map image transmitting unit **125** transmits the data of the heat map image to the HMDs **21** to **24**, and then ends the processing.

For example, every time the aggregation method is designated by the performers, the processing of FIG. **18** is performed, and the heat map image is transmitted to the display control apparatus **2**. Every time the performers designate the aggregation method, the performers can switch display of the heat map image.

Next, with reference to a flowchart of FIG. **19**, processing of the display control apparatus **2** that displays the heat map image will be described.

In step S**41**, the aggregation method acquisition unit **163** receives the aggregation method designation information transmitted from the portable terminals the performers have.

In step S**42**, the designation information transmitting unit **164** transmits the aggregation method designation information received by the aggregation method acquisition unit **163** to the aggregation server **12**. In the aggregation server **12**, the processing of FIG. **18** is performed and the data of the heat map image is transmitted to the display control apparatus **2**.

In step S**43**, the heat map image receiving unit **161** determines whether the data of the heat map image has been transmitted from the aggregation server **12**. The heat map image receiving unit **161** stands by until determination is made that the data has been transmitted.

When the determination is made in step S**43** that the data of the heat map image has been transmitted from the aggregation server **12**, in step S**44**, the heat map image receiving unit **161** receives the data of the heat map image.

In step S45, the display control unit 162 causes the large display 3 to display the heat map image on the basis of the data received by the heat map image receiving unit 161.

By seeing the heat map image displayed on the large display 3, the performers and the spectators who are in the event venue, and the spectators who are at distant location can share an atmosphere of the concert.

Next, with reference to a flowchart of FIG. 20, processing of the HMD 21 as the client terminal that displays the heat map image will be described.

The processing of FIG. 20 starts, for example, when display of the heat map image is instructed while the live content is watched. When display of the heat map image is instructed, the aggregation method of the degree of excitement is designated by the user.

Thus, the users of the HMDs 21 to 24 can also designate the aggregation method of the degree of excitement. The processing described with reference to FIG. 18 is performed by the aggregation server 12 in accordance with the aggregation method designated by the users of the HMDs 21 to 24, and then the heat map image is transmitted, for example, to the HMD 21.

In step S51, the communication unit 52 transmits the aggregation method designation information that designates the aggregation method designated by the user to the aggregation server 12.

In step S52, the communication unit 52 determines whether the data of the heat map image has been transmitted from the aggregation server 12. The communication unit 52 stands by until the determination is made that the data has been transmitted.

When the determination is made in step S52 that the data of the heat map image has been transmitted from the aggregation server 12, in step S53, the communication unit 52 receives the data of the heat map image. The data of the heat map image is supplied to the display control unit 93 via a path which is not illustrated.

In step S54, the display control unit 93 causes the display 54 to display the heat map image superimposed on the video of the live content.

FIG. 21 is a diagram illustrating a display example of the display 54.

In the example of FIG. 21, a heat map image P superimposed on the video of the live content is displayed in an upper right of the display 54. The user of the HMD 21 can check the degree of excitement of the spectators who are at distant location by seeing the heat map image generated in accordance with the aggregation method specified by the user.

By a series of the aforementioned processing steps, the aggregation server 12 can acquire the excitement information on the spectators who are at distant location in a more natural way without causing the users who are watching the live content to perform active operations. In addition, by transmitting the heat map image that visualizes the excitement information to the event venue and causing the large display 3 to display the heat map image, the aggregation server 12 can present the degree of excitement of the spectators who are at distant location to the performers and the spectators in an easier-to-see way.

<Example of Heat Map Image>

As described above, the performers can switch display of the heat map image by designating the aggregation method.

FIG. 22 is a diagram illustrating another example of the heat map image. The heat map image of FIG. 22 is an image made by arranging a shade of color indicating the degree of excitement outward from a center in decreasing order of the degree of excitement. The degree of excitement is determined, for example, on the basis of "intensity of motion of the head."

The performers can change the heat map image of FIG. 7 to display of FIG. 22, for example, by designating the aggregation method.

The shade of color may be arranged at a position according to a user ID as the attribute of each user.

Also, the heat map image may be displayed with the information indicating the degree of excitement of each national origin of the user arranged together as illustrated in FIG. 23, instead of each area inside Japan.

In the example of FIG. 23, the information indicating the degree of excitement of the users from the United States indicated by their attribute is arranged in an upper left region of the large display 3. In addition, the information indicating the degree of excitement of the users from India is arranged in a lower left region of the large display 3.

Thus, the performers can designate various methods as the method for arranging the information indicating the degree of excitement of each user.

For example, it is also possible to arrange together the information indicating the degree of excitement of the users who have a common favorite performer.

When the performers are persons H1, H2, and H3, the information indicating the degree of excitement of the user who likes the person H1, the information indicating the degree of excitement of the user who likes the person H2, and the information indicating the degree of excitement of the user who likes the person H3 are each collected and displayed in a predetermined region. Which performer each user likes is indicated by the favorite information included in the user attribute information.

This allows each performer to check the degree of excitement of fans of the performer.

In addition, it is also possible to arrange together the information indicating the degree of excitement of the users who see a common range.

When the performers are persons H1, H2, and H3, the information indicating the degree of excitement of the user who sees the person H1, the information indicating the degree of excitement of the user who sees the person H2, and the information indicating the degree of excitement of the user who sees the person H3 are each collected and displayed in a predetermined region. Where each user sees is indicated by the visual field information included in the user attribute information.

FIG. 24 is a diagram illustrating an example of switching display of the heat map image.

The heat map image illustrated on a left side of FIG. 24 is an image identical to the heat map image described with reference to FIG. 7. For example, when the performers select a region A11 and designate enlargement of the degree of excitement, the display control apparatus 2 enlarges and displays the information indicating the degree of excitement of the users assigned to the region A11 as illustrated on a right side of FIG. 24.

The display control apparatus 2 displays, for example, human-shaped icons as information that visually indicates the degree of excitement of the users. The human-shaped icons are displayed in color according to the degree of excitement.

Thus, when the degree of excitement of the large number of spectators is displayed collectively, the region assigned to each spectator in the entire large display 3 becomes relatively small. Conversely, when the degree of excitement of the small number of spectators is displayed, the region

assigned to each spectator becomes relatively large; at this time, the method for representing the degree of excitement can be changed. Thus, the information indicating the degree of excitement may be any information if the information can be checked visually.

By operating the portable terminals the performers have, the performers can select the region in which the degree of excitement is displayed, and can display enlarged information or reduced information indicating the degree of excitement.

<Variations>

The foregoing has described the examples in which the HMD is used as the client terminal; various devices having displays, such as a smartphone and a tablet terminal, can also be used as the client terminal.

During reproduction of the live content, the smartphone or tablet terminal as the client terminal detects the visual field of the user on the basis of the sensor data from an acceleration sensor or angular velocity sensor mounted thereon, and switches the display range of the video. Also, the smartphone or tablet terminal detects the motion of the user by analyzing an image of the user captured with a camera or on the basis of the sensor data, and then transmits the motion information to the aggregation server **12**.

In addition, the smartphone or tablet terminal can also detect the motion of the user on the basis of various operations such as an operation of repeatedly rubbing a display surface and an operation of repeatedly pushing a button displayed on the display. The display of the smartphone or tablet terminal is provided with a stacked touch panel, enabling detection of the operation of the user applied to the display.

Example of Content

The foregoing has described a case where the video obtained by capturing a state of the concert is distributed as the live content; it is also possible to distribute a video obtained by capturing a state of a lecture.

In this case, during reproduction of the live content, for example, the HMDs **21** to **24** each detect whether the user as a student taking the lecture is dozing on the basis of the sensor data, and then transmit detected information as the motion information to the aggregation server **12** together with the user attribute information. The aggregation server **12** identifies the dozing user, generates a map image indicating of which attribute the user is sleeping, and then transmits the map image to the display control apparatus **2**. The display control apparatus **2** causes the large display **3** to display the map image.

This allows a person as a teacher of the lecture to easily check of which attribute the user is sleeping.

Thus, the above-described technology can be applied to real time distribution of various moving pictures.

Also, in the foregoing, it is assumed that the content distributed is free visual point content; however, content of a normal moving picture with an unchangeable visual point or visual field may be distributed.

About Form of HMD

The description has been made on an assumption that the HMDs **21** to **24** are immersive HMDs; the above-described technology can be applied to so-called video see-through type HMDs and optical see-through type HMDs as well.

FIGS. **25**A, **25**B, and **25**C are diagrams illustrating an example of a form of the HMD.

As illustrated in FIG. **25**B, the video see-through type HMD is identical to the immersive HMD in that the display is provided at a position where the video is projected in front of eyes of the user who wears a body. However, the video see-through type HMD is different from the immersive HMD in that a camera is provided in an enclosure of the HMD and a video of a scene ahead of the user captured with the camera is displayed on the display.

As illustrated in FIG. **25**C, the optical see-through type HMD is an HMD with a half mirror provided in front of the eyes of the user who wears the HMD, which allows the user to see the scene ahead through the half mirror. Light of various types of information, such as the video of the live content, that is output from a light-emitting part provided in a section such as a frame section of the HMD is reflected by the half mirror and then guided to the eyes of the user. The user can see various types of information superimposed on the scene in front of the eyes.

About Program

A series of processing steps described above can be performed by hardware, and can be performed by software. When the series of processing steps is performed by software, a program that constitutes the software is installed in a computer built into dedicated hardware, a general-purpose personal computer, or the like.

The program to be installed is recorded and provided in the removable medium **111** illustrated in FIG. **11** including an optical disc (such as a compact disc-read only memory (CD-ROM) and a digital versatile disc (DVD)), a semiconductor memory, and the like. In addition, the program to be installed may be provided via a wired or wireless transmission medium, such as a local area network, the Internet, and digital broadcasting. The program can be installed in the ROM **102** or the recording unit **108** in advance.

It is to be noted that the program to be executed by the computer may be a program that performs processing on a time-series basis in order described in the present specification, or may be a program that performs processing in parallel or at necessary timing such as when called.

It is to be noted that in the present specification, the system means a set of a plurality of components (apparatus, module (part), and the like), and it does not matter whether all the components are inside the same enclosure. Therefore, a plurality of apparatuses which are contained in separate enclosures and connected via a network, and one apparatus with an enclosure that contains a plurality of modules are all systems. The embodiment of the present technology is not limited to the above-described embodiment, and various changes can be made without departing from the spirit of the present technology.

For example, the present technology can have a configuration of cloud computing in which one function is divided among a plurality of apparatuses and is jointly processed via a network.

Also, each step described in the aforementioned flowcharts can be performed by one apparatus, and can also be performed by dividing the step among a plurality of apparatuses.

Furthermore, when one step includes a plurality of processing steps, the plurality of processing steps included in the one step can be performed by one apparatus, and can also be performed by dividing the processing steps among the plurality of apparatuses.

Effects described in the present specification are only illustrative and not restrictive, and other effects may be obtained.

<Example of Combination of Configurations>

The present technology can also have the following configurations.

(1)

An information processing apparatus including:

a receiving unit configured to receive motion information indicating a motion of a user who is watching video content and information indicating an attribute of the user transmitted from a reproducing apparatus that receives and reproduces the real time video content with a display range switched following the motion of the user who is a viewer within a range of a captured entire video;

a generation unit configured to generate an excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and

a transmitting unit configured to transmit data of the excitement image to a display control apparatus that causes a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image.

(2)

The information processing apparatus according to (1), wherein the generation unit generates the excitement image with a color according to the degree of excitement of the user arranged at the position according to the attribute of the user.

(3)

The information processing apparatus according to (1), wherein the generation unit generates the excitement image with an icon according to the degree of excitement of the user arranged at the position according to the attribute of the user.

(4)

The information processing apparatus according to any of (1) to (3), wherein the attribute of the user is at least one of a position of the user who is watching the video content, a favorite person of the user among a plurality of persons reflected in the video, and a visual field of the user corresponding to the display range.

(5)

The information processing apparatus according to any of (1) to (4), wherein

the receiving unit receives designation information transmitted from the display control apparatus, the designation information indicating a method for determining the degree of excitement based on the motion information and a method for arranging the information that visually indicates the degree of excitement, and

the generation unit generates the excitement image by determining the degree of excitement in accordance with the method for determination indicated by the designation information and by arranging the information that visually indicates the degree of excitement in accordance with the method indicated by the designation information.

(6)

The information processing apparatus according to (5), wherein the method for determining the degree of excitement and the method for arranging the information that visually indicates the degree of excitement are designated by a person reflected in the video.

(7)

An information processing method including the steps of:

receiving motion information indicating a motion of a user who is watching video content and information indicating an attribute of the user transmitted from a reproducing apparatus that receives and reproduces the real time video content with a display range switched following the motion of the user who is a viewer within a range of a captured entire video;

generating an excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and

transmitting data of the excitement image to a display control apparatus that causes a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image.

(8)

A program for causing a computer to perform processing including the steps of:

receiving motion information indicating a motion of a user who is watching video content and information indicating an attribute of the user transmitted from a reproducing apparatus that receives and reproduces the real time video content with a display range switched following the motion of the user who is a viewer within a range of a captured entire video;

generating an excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and

transmitting data of the excitement image to a display control apparatus that causes a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image.

(9)

A display control apparatus including:

a receiving unit configured to receive motion information indicating a motion of a user who is watching video content and information indicating an attribute of the user transmitted from a reproducing apparatus that receives and reproduces the real time video content with a display range switched following the motion of the user who is a viewer within a range of a captured entire video, and to receive data of an excitement image transmitted from an information processing apparatus that generates the excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and

a display control unit configured to cause a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image on the basis of the data of the excitement image.

(10)

The display control apparatus according to (9), wherein

the receiving unit receives designation information designated by a person reflected in the video, the designation information indicating a method for determining the degree of excitement based on the motion information and a method for arranging the information that visually indicates the degree of excitement, and

the display control apparatus further includes a transmitting unit configured to transmit the designation information to the information processing apparatus.

(11)

A display control method including the steps of:

receiving motion information indicating a motion of a user who is watching video content and information indicating an attribute of the user transmitted from a reproducing apparatus that receives and reproduces the real time video content with a display range switched following the motion of the user who is a viewer within a range of a captured entire video, and to receive data of an excitement image transmitted from an information processing apparatus that generates the excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and

causing a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image on the basis of the data of the excitement image.

(12)

A program for causing a computer to perform processing including the steps of:

receiving motion information indicating a motion of a user who is watching video content and information indicating an attribute of the user transmitted from a reproducing apparatus that receives and reproduces the real time video content with a display range switched following the motion of the user who is a viewer within a range of a captured entire video, and to receive data of an excitement image transmitted from an information processing apparatus that generates the excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and

causing a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image on the basis of the data of the excitement image.

(13)

A reproducing apparatus including:

a receiving unit configured to receive real time video content with a display range switched following a motion of a user who is a viewer within a range of a captured entire video;

a reproducing unit configured to reproduce the video content;

a detection unit configured to detect the motion of the user;

a display unit configured to display the video of the display range according to the motion of the user; and

a transmitting unit configured to transmit motion information indicating the motion of the user who is watching the video content to an information processing apparatus that aggregates the motion information together with information indicating an attribute of the user.

(14)

The reproducing apparatus according to (13), wherein the motion detection unit detects a plurality of types of motion of the user.

(15)

A reproducing method including the steps of:

receiving real time video content with a display range switched following a motion of a user who is a viewer within a range of a captured entire video;

reproducing the video content;

detecting the motion of the user;

displaying the video of the display range according to the motion of the user; and

transmitting motion information indicating the motion of the user who is watching the video content to an information processing apparatus that aggregates the motion information together with information indicating an attribute of the user.

(16)

A program for causing a computer to perform processing including the steps of:

receiving real time video content with a display range switched following a motion of a user who is a viewer within a range of a captured entire video;

reproducing the video content;

detecting the motion of the user;

displaying the video of the display range according to the motion of the user; and

transmitting motion information indicating the motion of the user who is watching the video content to an information processing apparatus that aggregates the motion information together with information indicating an attribute of the user.

(17)

An information processing system including:

a reproducing apparatus including:

a receiving unit configured to receive real time video content with a display range switched following a motion of a user who is a viewer within a range of a captured entire video;

a reproducing unit configured to reproduce the video content;

a detection unit configured to detect the motion of the user;

a display unit configured to display the video of the display range according to the motion of the user; and

a transmitting unit configured to transmit motion information indicating the motion of the user who is watching the video content to an information processing apparatus that aggregates the motion information together with information indicating an attribute of the user,

the information processing apparatus including:

a receiving unit configured to receive the motion information and the information indicating the attribute of the user transmitted from the reproducing apparatuses;

a generation unit configured to generate an excitement image by arranging information that visually indicates a degree of excitement of each of the users determined on the basis of the motion information transmitted from the plurality of reproducing apparatuses at a position according to the attribute of each of the users; and

a transmitting unit configured to transmit data of the excitement image to a display control apparatus that causes a display apparatus installed in space where capturing of the video of the video content is performed to display the excitement image, and

the display control apparatus including:

a receiving unit configured to receive the data of the excitement image transmitted from the information processing apparatus; and

a display control unit configured to cause the display apparatus installed in the space where the capturing of the

video of the video content is performed to display the excitement image on the basis of the data of the excitement image.

REFERENCE SIGNS LIST

1 Capturing control apparatus
2 Display control apparatus
3 Large display
11 Distribution server
12 Aggregation server
21 to **24** HMD
121 Motion information receiving unit
122 Motion information recording unit
123 Excitement aggregation unit
124 Designation information receiving unit
125 Heat map image transmitting unit

The invention claimed is:

1. An information processing apparatus, comprising:
a receiving unit configured to:
receive motion information indicating a motion of a plurality of users,
wherein each user of the plurality of users watches video content through a corresponding reproducing device of a plurality of reproducing devices; and
receive information transmitted from the plurality of reproducing devices that receives and reproduces the video content,
wherein the received information indicates an attribute of each user of the plurality of users;
a generation unit configured to generate an image by arrangement of condition information that indicates a condition of each user of the plurality of users,
wherein the condition is determined based on the motion information and the attribute of each user of the plurality of users; and
a transmitting unit configured to transmit data of the image to a display control apparatus that controls a display apparatus to display the image,
wherein the display apparatus is installed in a space where a video of the video content is captured.

2. The information processing apparatus according to claim **1**, wherein
the condition is a degree of excitement,
the generation unit is further configured to generate the image including a color image based on the degree of excitement of each user of the plurality of users, and
a position of the color image in the image is based on the attribute of a corresponding user of the plurality of users.

3. The information processing apparatus according to claim **1**, wherein
the condition is a degree of excitement,
the generation unit is further configured to generate the image including an icon based on the degree of excitement of each user of the plurality of users, and
a position of the icon in the image is based on the attribute of a corresponding user of the plurality of users.

4. The information processing apparatus according to claim **1**, wherein the attribute of a user of the plurality of users is at least one of a position of the user, a favorite person of the user among a plurality of persons reflected in the video content, or a visual field of the user corresponding to a display range of the video content.

5. The information processing apparatus according to claim **1**, wherein
the condition is a degree of excitement,
the receiving unit is further configured to receive designation information transmitted from the display control apparatus,
the designation information indicates a method for determination of the degree of excitement based on the motion information and a method for the arrangement of the condition information that visually indicates the degree of excitement, and
the generation unit is further configured to generate the image by
the determination of the degree of excitement based on the method for the determination indicated by the designation information, and
the arrangement of the condition information that visually indicates the degree of excitement.

6. The information processing apparatus according to claim **5**, wherein the method for the determination of the degree of excitement and the method for the arrangement of the condition information that visually indicates the degree of excitement are designated by a person reflected in the video content.

7. An information processing method, comprising:
receiving motion information indicating a motion of a plurality of users,
wherein each user of the plurality of users watches video content through a corresponding reproducing device of a plurality of reproducing devices;
receiving information transmitted from the plurality of reproducing devices that receives and reproduces the video content,
wherein the received information indicates an attribute of each user of the plurality of users;
generating an image by arrangement of condition information that indicates a condition of each user of the plurality of users,
wherein the condition is determined based on the motion information and the attribute of each user of the plurality of users; and
transmitting data of the image to a display control apparatus that controls a display apparatus to display the image,
wherein the display apparatus is installed in a space where a video of the video content is captured.

8. A non-transitory computer-readable medium having stored thereon computer-executable instructions that, when executed by a computer, cause the computer to execute operations, the operations comprising:
receiving motion information indicating a motion of a plurality of users,
wherein each user of the plurality of users watches video content through a corresponding reproducing device of a plurality of reproducing devices;
receiving information transmitted from the plurality of reproducing devices that receives and reproduces the video content,
wherein the received information indicates an attribute of each user of the plurality of users;
generating an image by arrangement of condition information that indicates a condition of each user of the plurality of users,
wherein the condition is determined based on the motion information and the attribute of each user of the plurality of users; and

transmitting data of the image to a display control apparatus that controls a display apparatus to display the image,

wherein the display apparatus is installed in a space where a video of the video content is captured.

9. A display control apparatus, comprising:

a receiving unit configured to:

receive motion information indicating a motion of a plurality of users,

wherein each user of the plurality of users watches video content through a corresponding reproducing device of a plurality of reproducing devices;

receive information transmitted from the plurality of reproducing devices that receives and reproduces the video content,

wherein the received information indicates an attribute of each user of the plurality of users; and

receive data of an image transmitted from an information processing apparatus, wherein

the information processing apparatus generates the image by arrangement of condition information that indicates a condition of each user of the plurality of users, and

the condition is determined based on the motion information and the attribute of each user of the plurality of users; and

a display control unit configured to control, based on the received data, a display apparatus to display the image,

wherein the display apparatus is installed in a space where a video of the video content is captured.

10. The display control apparatus according to claim **9**, wherein

the condition is a degree of excitement,

the receiving unit is further configured to receive designation information designated by a person reflected in the video content,

the designation information indicates a method for determination of the degree of excitement based on the motion information and a method for the arrangement of the condition information that visually indicates the degree of excitement, and

the display control apparatus further comprises a transmitting unit configured to transmit the designation information to the information processing apparatus.

11. A display control method, comprising:

receiving motion information indicating a motion of a plurality of users,

wherein each user of the plurality of users watches video content through a corresponding reproducing device of a plurality of reproducing devices;

receiving information transmitted from the plurality of reproducing devices that receives and reproduces the video content,

wherein the received information indicates an attribute of each user of the plurality of users;

receiving data of an image transmitted from an information processing apparatus, wherein

the information processing apparatus generates the image by arrangement of condition information that indicates a condition of each user of the plurality of users, and

the condition is determined based on the motion information and the attribute of each user of the plurality of users; and

controlling, based on the received data, a display apparatus to display the image,

wherein the display apparatus is installed in a space where a video of the video content is captured.

12. A non-transitory computer-readable medium having stored thereon computer-executable instructions that, when executed by a computer, cause the computer to execute operations, the operations comprising:

receiving motion information indicating a motion of a plurality of users,

wherein each user of the plurality of users watches video content through a corresponding reproducing device of a plurality of reproducing devices;

receiving information transmitted from the plurality of reproducing devices that receives and reproduces the video content,

wherein the received information indicates an attribute of each user of the plurality of users;

receiving data of an image transmitted from an information processing apparatus, wherein

the information processing apparatus generates the image by arrangement of condition information that indicates a condition of each user of the plurality of users, and

the condition is determined based on the motion information and the attribute of each user of the plurality of users; and

controlling, based on the received data, a display apparatus to display the image,

wherein the display apparatus is installed in a space where a video of the video content is captured.

13. An information processing system, comprising:

an information processing apparatus comprising:

a first receiving unit configured to:

receive motion information indicating a motion of a plurality of users,

wherein each user of the plurality of users watches video content through a corresponding reproducing device of a plurality of reproducing devices; and

receive information transmitted from the plurality of reproducing devices that receives and reproduces the video content,

wherein the received information indicates an attribute of each user of the plurality of users; and

a generation unit configured to generate an image by arrangement of condition information that indicates a condition of each user of the plurality of users,

wherein the condition is determined based on the motion information and the attribute of each user of the plurality of users; and

a display control apparatus comprising:

a second receiving unit configured to receive data of the image transmitted from the information processing apparatus; and

a display control unit configured to control, based on the received data, a display apparatus to display the image,

wherein the display apparatus is installed in a space where a video of the video content is captured.

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